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YESTER DEEP LAND-CULTURE.

It has been pretty generally known, from casual notices in the newspapers and other sources, that the Marquess of Tweeddale has been engaged, for several years, in carrying on extensive agricultural improvements on certain parts of his property in East Lothian. It was early understood that these were partly of an experimental character, comprehending operations affecting the most important processes of husbandry; and from his lordship's well-known inventive faculty as an experimentalist, together with his perseverance and skill as a practical farmer, considerable interest could not fail to be felt in the results. These results, as realised, from time to time transpired, and they were such as not only to surpass what the most sanguine improver could have anticipated, but even to excite no small degree of surprise. Now that the entire process of improvement has been completed, and the success of the means employed fully established, an account of the whole has, at the Marquess's desire, been drawn up by Mr Stephens, and published in the work mentioned below,* not only that the curiosity of the agricultural community may be gratified, but that they may have it in their power to put in practice the new system, and benefit by his lordship's discoveries, inventions, and experience.

A more able expositor of the Marquess's views and practice could not well have been found than the author of *The Book of the Farm.* Familiar with all the different existing modes of culture, no one is better acquainted with their merits and defects, and more able to appreciate justly the real value of what claims attention as a new and important process. He informs us that, since improve-

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* *The Yester Deep Land-Culture; being a detailed Account of the Method of Cultivation which has been successfully practised for several Years by the Marquess of Tweeddale at Yester.* By Henry Stephens, F.R.S.E., Author of *The Book of the Farm.* Wm. Blackwood and Sons, Edinburgh and London. 1855.

ments were begun at Yester in 1832, he has had many opportunities of witnessing all the different operations put in practice; and, early impressed with their importance, as the foundation of a mode of farming so very different from what is in ordinary use as to merit the appellation of a New System, he viewed them from the first with a high degree of interest. In directing public attention to them, he has made it his endeavour, he informs us, to do so in terms the most succinct, clear, unexaggerated, and practical he could command; and we must be permitted to congratulate him on having fully accomplished his object. A more distinct and lucid statement—one which conveys more readily to the mind of the reader a clear conception of the whole case—we have seldom happened to peruse; while the more scientific bearings of the subject are treated in a manner which leaves little to be desired.

The Yester mode of cultivation, as far as it has the character of an original process, may be expressed in a few words: It is a method of breaking up and pulverising the subsoil to a considerable depth, and then raising it upwards so as to mix it, in any required quantity, with the surface-soil; and this it effects by means of a subsoil-trench-plough of peculiar construction. But its chief merit is not seen in regarding it simply by itself; it admirably adapts itself to the other great ameliorating processes to which the soil is subjected, and renders them more complete. Assuming thorough-draining as an essential prerequisite, it appears to be the only method hitherto devised which, on the one hand, gives full effect to that operation, and derives from it all the advantages of which it is susceptible; while, on the other, it deepens and improves the plant-growing soil, and brings it into a condition which best fits it for benefiting from manures and atmospheric influences. It may be regarded, therefore, not only as an important discovery in itself, but also just such a one as was needed to give full effect to many of the most important improvements lately introduced into agriculture. This will appear more fully as we follow Mr Stephens into some of the details with which his work furnishes us.

The lands which have been the subject of these operations consist of three farms, lying chiefly in the parish of Yester, and extending to not much short of 1000 acres. Occupying the inclined plane formed by the northern slope of the Lammermuirs, they are averted from the direct rays of the sun, and rise from 400 to 750 feet above the level of the sea. The fall of rain in 1853 is stated at 22.6 inches, and in 1854 at 19.6 inches, from which the general average may be inferred. The mean annual temperature is about 44°. The geological character of the district is not particularly specified by Mr Stephens—an omission which will perhaps be regretted by some of his readers. The prevailing formation is the carboniferous, forming a part of the great Lothian coal-field; and the lands in question have, no doubt, for their subjacent rock, chiefly the sand-

stones of the coal formation. Upon these the transition rocks of the Lammermuir range appear occasionally to obtrude; and there are probably some portions of trap. The more superficial deposits consist of clay of various colours and consistency, and containing numerous boulders, or rolled pieces of rock, often of considerable dimensions. This is sometimes surmounted by deposits of gravel. In the lower portions of the district, true alluvial deposits occur. Formed chiefly by the decomposition of the sandstone rocks, the surface-soil contains, for the most part, a considerable portion of sand. A large proportion of the surface of Yester Mains, before it was improved, consisted of a thin wet clay; that of Danskine of poor stiff sandy clay, with interspersed patches of bog; that of Broadwoodside partly of the same, and partly of a poor stiff tenacious clay. These facts are sufficient to show that the Marquess had few natural advantages in his favour, either in the physical condition of the country, or the character of the soil; and this circumstance testifies strongly to the excellence of the principle by which such important results have been obtained from subjects so unpromising. Before the improvements in question were commenced, 228 acres were valued at 7s. an acre; 235 at 10s. an acre; and the rest at about 14s. per acre. So inferior was the soil of Yester (the best portion of the lands) generally regarded by the neighbouring farmers, that one of them was heard facetiously to remark, that "he hoped the Marquess of Tweeddale would always keep Yester Mains in his own hand, as it would give him a very good idea what his land was worth."

As might have been expected from the nature of the subjacent rocks, the subsoil is occasionally sandy and friable—so much so on the lands of Danskine, that after breaking through a layer of moorband-pan, it was found sufficiently open to admit of subsoil trench-ploughing being dispensed with. In other instances the subsoil consisted chiefly of variously coloured clay, stiff and retentive. The moorband-pan was of "two different textures, one fine-grained, the other coarse-grained, cemented together in a black ferruginous matrix. They were found about 8 inches under the surface. The fine-grained was light in colour, and formed a continuous bed of several yards' extent in length and breadth. The coarse-grained occurred chiefly in masses. The pan was from the thickness of a film to 3 or 5 inches. It yielded to the plough in many cases; in others it had to be broken up with hand-picks. On exposure to the air or frost, both kinds mouldered down into their constituent parts, and would have easily incorporated with the soil, but, having risen in masses when brought to the surface, were carried off the fields along with the stones. More than one year elapses ere the pan entirely moulders away."—P. 21.

As the basis of all improvement in such a case, without which every other operation would have been impracticable or nugatory,

The immediate effect (says Mr Stephens) of the broad-feathered sock operating on the subsoil, is to cut the furrow-sole smooth and entirely flat, in order that no hard ridglets of the subsoil shall be left standing on the bottom of the furrow. The bottom furrow thus cut smooth and flat, at least 19 inches below the surface, the loose subsoil raised from it is carried along the sock in an inclined plane in an upward direction, to bring it within reach of the surface-soil. When it has reached the top of the inclined plane, by which it has been elevated 9 inches above the bottom furrow, it falls over its ends and sides, bringing in its fall a portion of the surface-soil, and both are commixed before reaching the bottom of the furrow, to fill up the void continually forming under the inclined plane or tail-board in its passage through the subsoil. So intimately are the soil and subsoil thus commixed, that on digging pits through the ploughed and trenched soil and subsoil with the spade, there is an immediate alteration ; but in a year or two afterwards the mixture appears all upper soil, and the subsoil to have disappeared. . . . . The immediate effect of this mode of subsoil-trench-ploughing is to pulverise the entire ground to the depth of both soil and subsoil. The soil and subsoil are more intimately mixed by this mode of subsoil-trench-ploughing than by the spade, and the reason is easily given. The subsoil-trench-plough raises up a portion of the subsoil by degrees, and rubs it against a corresponding portion of the upper soil, laid over in the furrow-slice by the plough that has gone before ; and on the subsoil losing the support of the inclined plane of the subsoil-trench-plough, both sorts of soil fall together over the end and sides of the incline upon the bottom furrow ; whereas, when soils are mixed in trenching by men with the spade, masses in spadefuls are placed together, side by side, and not innumerable small portions of mixed loose mould. A great difference exists between a mixture of spadefuls and that of loose mould.—P. 46.

In the case of the Yester farms, the operations of both the ploughs in question were much obstructed by the occurrence of boulders. For a time these were the cause of much annoyance in the breakage of harness and implements, fretting the horses, &c., until the plan was adopted of allowing the horses to take their own way, when they instantly stood still on encountering such an obstacle, the plough was slipped over it, and the place marked that the stone might be immediately removed. Similar obstruction was occasioned by the moorband-pan, which was found in many places about 8 inches under the surface, and from 4 to 5 inches thick. When not of great thickness, it was readily broken up by the plough; but in other instances it had to be cut through on the land side of the furrow with the mattock. This substance was found chiefly in the wettest part of the fields; and after the moisture was removed, it showed no tendency to form again. By both of these obstructions a considerable amount of additional labour and expense was necessarily occasioned ; but as they are incident only to certain localities, they need not generally be taken into account in the estimate of the cost attending this operation. Allowance being made for them in this instance, the entire cost of subsoil-trench-ploughing on the Yester farms stands as follows :—

Four men and four pairs of horses trench-ploughing an imperial acre a-day, at 12s. each pair, ...	£2	8	0
One man turning out stones, per acre, . . .	0	2	0
Carting and sledging off stones, per acre, . . .	0	3	0
Making the cost per imperial acre, . .	£2	13	0

If we add to this the expense of thorough-draining, formerly mentioned, the conjoint cost amounts to £8, 2s. 6d. per imperial acre. When we consider the effective manner in which these two great fundamental operations were performed, their permanent character, and the vast improvement effected, as evinced by the quantity and quality of the produce, we cannot regard this expenditure as in any degree excessive: on the contrary, it is such as may be incurred even in unfavourable circumstances, as in the case before us, with every prospect of an adequate remuneration.

Into the consideration of the system of farming, as practised at Yester, after the improvements above mentioned were completed, it is unnecessary to enter in this place. It was judiciously adapted to the altered state of the soil and subsoil, and the greatly-amended conditions in which the crop was in every respect to be placed. But even in his ultimate treatment of the soil, and its ordinary preparation for cropping, the Marquess is an advocate for much deeper ploughing than is usually practised—as indeed might have been expected from a due appreciation of the principles on which the advantages of trench-ploughing in a great measure depend. He is of opinion that no furrow should be less than 8 inches in depth for a seed-furrow, and 10 inches for lea-ploughing. And conformably with this view, he has constructed what is called the *Yester Plough*, which, of smaller size than the Tweeddale plough, and drawn by two horses, has its mould-board formed on the same principles as the last-named instrument. It readily attains the desired depth, and although the furrow-slice does not appear so smooth and perfect as in lea-ploughing by the ordinary ploughs, the work is yet considered highly satisfactory, as it brings the soil into an excellent state for easy working, safe sowing, and easy harrowing.*

But let us now briefly advert to the results obtained by this process of culture, without, in the meanwhile, entering further into its details, which will be best learnt from Mr Stephens' account.

The estimated money value of these farms, before the improvements were undertaken, has been already mentioned; it did not exceed, on an average, 10s. an acre. They are now regarded as worth 45s. or 50s. per acre. Wheat was formerly attempted to be grown at Danskine after bare fallow; but in some seasons the crop was so poor as not to be worth the cost of reaping. Turnips were raised on the driest and best part of a field; but neither they nor the pasture, in the best seasons, were fitted to fatten stock. The contrast between this and the subsequent state of things is very striking. The crop of wheat, on a portion of the same farm, in 1852, was 5½ quarters per imperial acre, and was of a quality

* See this Journal for January 1850, p. 265.

to weigh 18 stones, 13 lb. per boll of 4 bushels, or 66¼ lb. per bushel—a great weight, as Mr Stephens may well remark, for wheat grown upwards of 700 feet above the level of the sea. A subsequent crop of hay, on the same field, amounted to 250 stones per imperial acre. 26½ acres of another field, on the same farm, produced, in 1853, 22¾ bushels of wheat the acre, realising £10, 1s. 4d. the acre; and the remaining 16¾ acres produced 38¼ bushels of barley the acre, realising £9, 2s. 6d., so that the whole produce of the field that year realised £436, 12s. 1½d. Before thorough-drainage, the oats on Danskine farm yielded about 30 bushels the acre; after that operation the yield was above 40 bushels. When deep-ploughing and manuring were superadded, the increase exceeded 40 bushels of wheat—instead of 30 bushels of oats—an increase in weight of grain of at least 630 lb. to the acre. Part of this improved fertility must be ascribed to a heavy manuring of black vegetable matter from an adjoining moss; but this would probably have been of comparatively little value but for the previous draining and deep-ploughing, for it is the property of these operations to give increased efficacy to every kind of manure that is applied. A field on Yester Mains, after subsoil-trench-ploughing, and manuring with farmyard dung on bare fallow, produced 38½ bushels of wheat per acre; previously to trench-ploughing, and after thorough-draining, the same field yielded only 29 bushels of oats. Another field, after the full process of improvement, yielded 61 bushels of oats the acre, previously only 37 bushels,—making a difference of 1080 lb. of grain per acre to testify in favour of the new system. An improved field on Broadwoodside produced 43¼ bushels of oats per acre in 1851, and 39 bushels of barley in 1853. These instances will be sufficient to convey some idea of the vast increase in produce resulting from the treatment to which the soil was subjected. But it is still more remarkable in the case of green crops, turnips, and grass. In fields where the crop of turnips did not previously exceed 12 or 15 tons the acre, 30 tons were afterwards obtained of the best quality. 250 stones of hay the acre must be regarded as a heavy crop; and the maintenance on the same space of three ewes, with their lambs, many of them double, testifies strongly to the feeding power of the herbage on the improved pastures. The quality of the grain has undergone an improvement no less striking than the increase in quantity. The wheat is clear and flinty, indicating the presence of an unusually large proportion of gluten; and it, as well as the barley, now obtains the highest prices in the Haddington market, where it comes into competition with the best kinds of grain reared in the kingdom.

Such are the nature and extent of the benefits arising from the method of culture which we have briefly indicated rather than described. They are so striking and important that they cannot

be regarded in any other light than as affording decisive evidence as to the soundness of the principles on which the system is founded. They have been demonstrated in so many instances, and in such a variety of circumstances, as to exclude the idea of any accidental advantages having influenced the results; and we may safely affirm that this method rests its claims to general adoption on its intrinsic merits. It would be highly satisfactory if we could appreciate or estimate the influence of all the circumstances connected with this process, which contribute to the increased fertility of the soil, and improvement in the character of its produce. Even in the present improved state of our knowledge of scientific agriculture, this, however, cannot be done. But some of these influences are sufficiently obvious; of others, more latent, we can infer the beneficial action; and it is important to remark, that as far as we can form an idea of them, the method of cultivation in question appears fitted to execute them to full operation, and turn them to the best possible account.

With the notions which formerly prevailed on the subject, it must have appeared an obvious objection to the Marquess's system, to mix the supposed useless, and in many cases deleterious, substance of the subsoil with the well-conditioned upper mould. It was natural to think that the bad qualities of the former would not only render it worthless in itself, but that it would impart them more or less to the soil with which it was thus brought in contact. Now it is in opposition to this long-established and very natural conviction that agriculturists must hasten to realise the important fact, that subsoil, *of whatsoever description*, can by one process be rendered innocuous, and, by another and subsequent process, be made positively useful. From being an unsafe, it can be rendered a safe substance; nay, from being a poison it can be converted into a nutriment to plants. By being thoroughly dried its nature is entirely altered; it becomes more or less friable, and only requires to be broken up, comminuted, and upraised, in order to be laid open to the action of new influences, to enter into new combinations, and gradually acquire the character of a plant-rearing substance. If the process be carried on too hastily, or too large a quantity of the subsoil be all at once thrown among the surface-soil, a temporary injury may be occasioned to the latter. It is indeed candidly admitted that this happened in some instances on the Yester farms, especially in fields where the subsoil consisted of a very bad poor clay. But even in these cases it was not long before a complete assimilation took place between the two ingredients. It may be mentioned as an instance of the chemical change produced by drying—in other words, thorough-draining the subsoil—that where oxide of iron exists, as it so often does in damp undrained land, it is in the state of protoxide, which is soluble in water, and always hurtful to vegetation; but when the land is

dried, the action of the air converts this protoxide into peroxide, which is insoluble in water, and therefore not injurious to vegetation. The experience of most cultivators has probably brought under their notice instances of the bad effects of subsoil; in all such cases it must be regarded as having been brought in contact with the roots of plants, or with a healthy soil, in an unfit state; it could not execute functions for which it was unprepared, and any other result than an unfavourable one could not reasonably be expected.

It may help to remove the erroneous notions that prevail respecting the character of subsoils, and also to illustrate the benefits of the operations to which we have been directing attention, to consider for a moment the manner in which soil fitted for the growth of plants was naturally at first formed, or is now in process of formation on parts of the earth's surface. When the great geological convulsions ceased, and the matter composing the earth's crust settled down to the configuration which its outline now presents, there could be no soil, properly so called, on its surface. That surface must have consisted either of naked rock, loose debris, or gravel, sand, and clay, produced by the action of water. But when these substances had been exposed for a length of time to the action of the atmosphere, and the various meteoric phenomena which take place in it, the surface would undergo a gradual change, portions would become disintegrated, and crumble down into fine particles. These in time would form an incipient soil, sufficient for the seeds of plants to germinate in; the plants would grow and decay, composing by their remains a vegetable earth to mingle with the mineral earth. For a length of time the soil, thus provided with its two proper ingredients, would continue to increase in quantity, receiving additions both from above and below,—above, from the further decay of vegetation, with the addition, at length, of a certain portion of decayed animal matter, and below; from the further disintegration of the rock, or debris of rocks. This process of double increase would continue till the soil became so thick as to form a covering sufficient to screen the subjacent substances from the action of the atmosphere, when they would cease to make any further contribution of materials to the soil, and sink into a state of comparative dormancy. The water that percolated through the layer of soil would stagnate among the substances lying beneath, become impregnated with iron and other mineral matter; and the process of change previously going on having terminated, the various substances would become inert, and more or less indurated, and that condition would be produced which we call subsoil. But as it was by intercepting the influence of the atmosphere that the underlying substances ceased to contribute to the soil, it is obvious that anything that tends to restore that influence will reinduce the same results as before. Let the whole stratum of soil be removed, and the process we have described will begin anew; or let it be

broken up, rendered thoroughly porous and permeable to the air, and the process will be continued; or, better still, let both the stratum of soil and the underlying substances be broken and stirred up, and the latter will be placed in the most favourable condition for receiving the influences by which they become more or less convertible into soil. It is not too much, therefore, to say that a large proportion of all the soils we now cultivate, (without taking into account alluvial soils, which are formed by a somewhat different kind of action)—that is, the mineral portion—has been produced from subsoil, or a condition of the surface similar to that of subsoil. It is, in fact, the natural reservoir for recruiting the plant-growing soil, and augmenting it in volume.

If this be the natural process in the formation of soil, it will readily be perceived how completely the Yester system conforms to it, and how well calculated it is to aid it where it is already going on, or to originate it where it is not in operation. The limit at which the natural process terminates, when the soil is left to itself, does not extend far below the surface; a comparatively thin stratum of compact earth seals up what lies below from undergoing material change, or being of any service to vegetation. But the new method of culture, with the peculiar instruments it employs, readily extends that limit, draws fresh materials from the stores below, and prepares a body of efficient soil, not only of sufficient mass for the rootlets of plants to penetrate to the requisite depth—a depth, in regard to the cereals, now admitted to be much greater than was formerly supposed—but also to place below them a stratum of dry and well-aerated soil, a circumstance most conducive to their healthy condition.

When we advert to the physical benefits arising from the Yester method of treating the soil, one of the first that strikes us is the increased degree of temperature. This we would naturally expect from one cause alone—namely, the subtraction of all superfluous moisture, which, if allowed to collect and remain stagnant, must necessarily tend to chill the whole soil in the vicinity. A series of observations were made, by means of thermometers, to ascertain whether an increase of temperature took place, and to determine the precise degree of it. A series of thermometers were placed in the soil, in different fields, at the depth of 18 inches, and their indications were carefully compared with other thermometers placed in the air above ground. At the depth mentioned, 18 inches, it was found that the instruments were not sensibly affected by changes of temperature in the atmosphere. Observations were also made to determine the temperature of the ground in its natural or unimproved state, in order that a direct comparison might be instituted with its temperature when it had undergone the full process of improvement. In its former condition, the mean temperature of one field, in the vegetating and non-vegetating seasons, was found to be

42°.33; of another field, 42°.42; after thorough-draining and subsoil-trench-ploughing, the mean temperature of the former of these was 45°.08.

Thus, in comparing the mean temperatures of the vegetating season, before and after thorough-draining and subsoil-trench-ploughing the same subsoil, the advantage is 2° in favour of the deep-stirred subsoil; and in the non-vegetating season the advantage is as great as 4°.25. The higher temperature in the winter is the greater advantage, as it tends to equalise the temperature of both seasons; and equalisation of temperature in summer and winter is a decided characteristic of an improved climate. The mean temperature throughout the year was raised 2°.75 by thorough-draining and subsoil-trench-ploughing. On comparing the relative effects of thorough-draining with thorough-draining and subsoil-trench-ploughing on the temperature of the subsoil, it appears that thorough-draining makes it warmer in winter to the extent of 2°.25; whereas the conjoined operations warm it 4°.25—that is, they nearly double the heat; and in summer the temperature is not raised at all by thorough-draining, for the reasons given on a former page; while the addition of subsoil-trench-ploughing raises it 2°.—P. 86.

A striking instance of the higher degree of warmth produced by subsoil-trench-ploughing than by thorough-draining, was afforded by two different portions of a field, one portion having undergone the former operation, the other the latter only. On the portion which had been only drained, the snow lay every year; on the rest of the field, which had undergone both operations, it lay comparatively a short time, a distinct line of demarcation forming the boundary between the two portions.

Great as are the benefits arising from this cause, we are yet disposed to regard them as secondary in importance to the complete aeration of the soil, which is secured to so great a depth by the Yester system. By no other process is the ground so thoroughly stirred and opened up; and the porosity thus produced must promote the circulation of air throughout its mass to a degree never before attained. Ordinary subsoiling does this most imperfectly; not to speak of its inconsiderable depth, it merely turns over the subsoil in stripes, when it soon becomes partially reconsolidated. Read's instrument is truly a pulveriser, but after breaking up the subsoil, it permits it to fall back again nearly to its former position, and makes no provision for a permanent alteration in its character. By the recent invention, not only is the subsoil displaced to a greater depth, but it is broken into fragments, which are lifted upwards and diffused on both sides; while the intermingled upper soil must tend to prevent consolidation, and to assimilate the crude matter to itself. Every new light that is thrown upon the constituent ingredients of the atmosphere, and their effect on vegetation, tends to show how desirable it is to stir the soil to a considerable depth, and to give free access to the air throughout its entire mass. Its effects are twofold: it acts directly, by imparting what has been called, with no great felicity of language, its manuring properties; and indirectly, by giving increased efficacy to every agent by which the growth of plants can be promoted. There is

every reason to believe that the quantity of ammonia, nitric acid, and that little-known substance ozone, especially the former, existing in the air, is much greater than has hitherto been supposed; for it must be admitted that the chemistry of the atmosphere is still in a very imperfect state. It is not long since M. Fresenius determined, by a series of accurate experiments, that 1,000,000 parts of atmospheric air contain, during the day, 0.098 parts of ammonia—a quantity equivalent to 0.283 parts of carbonate of ammonia. During the night the proportion is greater—namely, 0.169 parts of ammonia, or the equivalent of 0.474 parts of the carbonate. But it would appear from the investigations of Professor Way, Chemist to the Royal Agricultural Society of England, that the proportion greatly exceeds what has just been stated. The results of his inquiries on this subject, which are very striking, were given in a recent lecture, which is so apposite an illustration of the matter before us that we must make a short quotation from a report of it.

Professor Way called attention to the large amount of ammonia taken up by the soil, and washed into the land by the rain; and to the great importance, consequently, of exposing the soil in such a manner to the atmospheric influences as may tend to this ammoniacal absorption. Fallowing land, he remarked, had given way to rotation of crops, but that there was no such thing as a simple resting, as fallowing was supposed to imply in this case; for an alteration of the soil under the influence of oxygen was continually going on. Every interval, even between one crop and another, was in reality a fallow. Land should be laid as light as possible, for the purpose of its aeration. The working of land, with a view to this abundant aeration, was one important means of improvement. He regarded it as indispensable to the full development of the powers of the soil, that steam-power should be brought to bear effectively on its cultivation. The amazing amount of ammonia locked up in the land itself could not be taken up by plants, and would therefore remain in a form unavailable for vegetation, unless the management of the soil tended to release such manuring matter, and bring it within reach of the roots. He had calculated, from data furnished by some rich loamy land of tertiary drift, that the soil within available depth contained ammonia at the rate of one ton (equal to six of guano) per acre. This was a stock of wealth which would repay the most active measures being taken for its release and distribution.

If a method of treating the soil, with a view to its complete aeration, had to be devised in order to meet the enlightened opinions here expressed, it is not easy to see how one could have been found more appropriate and effectual than that which we have been considering.

These considerations must tend to produce dissatisfaction with the work of the common plough. Its action is not sufficiently powerful, nor is it of the kind best fitted for the proper cultivation of the soil. Penetrating only a few inches—from 4 to 7 or 8—in a lea field or a clayey soil, it turns over a compact stripe of earth, often with angles as sharp and well defined as if cut out of a block of timber; indeed, the regularity with which this is done is regarded as the perfection of ploughing, and in competitions the nicety of a furrow's crest often carries off the palm. What is the result of such a practice? A few inches of the surface-soil is up-

turned, and deposited in adhesive parallel slices, in a state, as far as depends on the plough, anything but pulverised, and most unfit to derive benefit from the air. And what is its state below? It rests on a uniform and hardened surface, rendered, by the passage of the polished irons, and the weight and pressure of the instrument, almost like a solid and continuous floor, sufficient to intercept all free communication with what lies beneath, whether it be soil or subsoil. If much depends, therefore, as is unquestionably the case, on the openness and porosity of the soil, this is the least likely way of attaining it. The truth is, that as a land-cultivator the principle of the plough, as it is generally used, seems to be erroneous. The impression, accordingly, is beginning to prevail, that all those applications of steam-power to the cultivation of the soil which merely aim at working with greater ease, and on an enlarged scale, some modified form or combination of ploughs, are most likely to prove unsatisfactory. When that wonderful agent is rendered available, as there can be little doubt it speedily will be, we may expect from it a greater revolution in agriculture than this would imply; its advantages will be realised by a more direct application, and a mode of operation more commensurate with the requirements of the soil and its own gigantic powers. What that *modus operandi* should be, certainly has not yet been discovered. With the full conviction that it is capable of accomplishing all that can be desired, we must remain in suspense till the grand problem be solved, which will enable it to do for agriculture what it is so successfully accomplishing in so many other departments. But let it be superseded when it may, it will be difficult to witness without regret the disappearance of the simple and graceful plough, so long the symbol and representative of the noblest of the arts, and to which we have been indebted for such important services in a former and less advanced stage of husbandry.

To the advantages already mentioned, resulting from this process as pursued at Yester, many others might be added; and taken conjointly, they are sufficient to account for the unusual degree of success that has attended it. Instead of further enlarging on them, we avail ourselves of the following admirable summary, as given by Mr Stephens :—

The porosity of the subsoil should assist in a marked degree the desiccating power of drains, and promote the circulation of air through its mass. Its capillarity should supply moisture from the effects of the drains below to the roots of plants growing in the upper soil, in proportion to the intensity of evaporation of the moisture from the surface in dry weather. In its comminuted state, it should absorb moisture from dews, and from the lower portion of the atmosphere at night in a period of drought. In its change of colour to a darker hue, from drainage and deep-ploughing, and by commixture with the surface-soil and manures, it should absorb a larger portion of solar heat and light than in its unchanged state. In its aluminous character it should absorb the free gases from the atmosphere, as well as from the air and rain which traverse it. The mixture of the constituents of the surface-soil and subsoil should induce action of the electric element. The great depth of pulverised subsoil should afford an extensive field for the food-searching fibres of en-

larging roots of plants to roam in; and it should place a large proportion of the subsoil itself beyond the reach of the ever-changing conditions of the seasons. Its general dryness should place the roots of plants in a medium safe from frosts; its divisibility should render every species of labour performed in it of easy execution. The variety of its constituents, consisting of organic and inorganic materials, of minerals, metals, and salts, should be ready to co-operate with any of the ingredients of the manures used in the surface-soil, and which may find their way into the subsoil, by means of rain or otherwise, as they are let loose by decomposition, and be there retained for the use of the roots of plants.—P. 135.

To the economical benefits arising from this process we can but slightly allude; but they are both numerous and important. The complete pulverisation of the soil and subsoil once accomplished, it saves so much labour in time to come, that six pair of horses can do what otherwise would have taken eight pair; less manure is required; deep-rooted weeds are eradicated; all other implements designed for the pulverisation of the soil, many of them cumbrous and expensive, may be dispensed with; the grain is better filled, and ripens more uniformly, while the harvest is earlier than before, a point of the utmost importance in our variable climate.

It is upwards of twenty years since Smith of Deanston made his views on draining and subsoil-ploughing known to the public. Although, in practice, they have been very far from realising the benefits expected of them, yet the movement was altogether in the right direction, and has led to more enlightened notions as to the manner in which the soil ought to be cultivated. His system of what he called "frequent" drains—that is, drains in each open furrow, and filled with small stones—led the way to the more expeditious and effective method of tile-draining, by which thorough-draining, on an extensive scale, was rendered a matter of comparatively easy accomplishment. His method of subsoil-ploughing is generally known, and the important points of distinction between it and the Marquess of Tweeddale's method will be sufficiently evident from what has already been said of the latter. We are not aware that great merit was ever denied to Mr Smith, both for what he actually accomplished in subsoil-ploughing, and the views regarding the advantages of deep cultivation which he at different times published. If his merits, as we have heard alleged, have not been properly acknowledged, it is just another of the too numerous instances of what is calculated for the public good not being duly appreciated by the public, and what it is the duty of every one to requite being, for that very reason, requited by none. But the truth is, that not only Mr Smith of Deanston's mode of subsoiling, but every other like it, have fallen almost into disuse. Subsoiling is very little practised—much less frequently than most people are aware. Even those who made a beginning many years ago, and purchased expensive implements for the purpose, after a brief trial felt no inducement to resume the practice. Not that they were persuaded of its inutility, but from the difficulty of executing it with any degree of satisfaction. The implements were cumbrous

and difficult to manage, and the moving power so ill applied that the operation was alike disagreeable to men and horses.

This evil is now remedied. The Yester implements, and mode of applying the power of draught, render the process of subsoil-trench-ploughing as easy as any furrow with three or four horses in the common plough. In this respect the mechanical skill visible in every part of the operations appears very conspicuous. This will remove what has tended perhaps more than anything else to bring the operation into disfavour, and, taken in connection with the other great and obvious benefits of this method, will, we doubt not, recommend it to general adoption. Already it has been put in practice by other proprietors, and will receive, therefore, the test of further trial, if any still desiderate stronger proofs of its merits than the amply sufficient ones already given. It is so rational in itself, founded so directly on the findings of experience, and the facts which science teaches us as to the physical and chemical properties of the soil and of plants, and the substances by which their growth is influenced—and is, moreover, so well calculated to develop and turn to the best account the many improvements recently introduced—that it may well be called a philosophical method of cultivating the soil; and as such its advantages will more and more appear, the more it is practised.

It is gratifying in the highest degree to find such a man as the Marquess of Tweeddale engaged, as he has been for a series of years, in experiments for the improvement of agriculture. The expenditure at once of time, thought, and money, which such investigations demand, places them for the most part beyond the power of the professional farmer; but even with these advantages at command, they are the least important requisites to success. An intimate acquaintance with agriculture, both in its practical and scientific relations, must be regarded as indispensable; but that also is a qualification which it requires no extraordinary powers or application to acquire. The origination of new views implies the exercise of a higher faculty; but even that might produce nothing more than a mere theorist in the art, if unaccompanied with the practical knowledge and mechanical skill necessary to carry such views into actual operation. These necessary qualities the Marquess possesses in an eminent degree, and they are happily united in his case with all adventitious facilities. Hence the important services he has already conferred on agriculture—first, by the invention of a drain-tile machine, by which thorough-draining was rapidly extended; and now, more especially, by this improved and novel form of subsoil-trench-ploughing, by which, in addition to its other peculiar advantages, all the benefits of thorough-draining are for the first time secured to us. Hence, also, we are authorised to feel confidence in the expectation that he will realise those improvements which he is attempting in various

kinds of cultivated roots and seeds, that he may find a superior class of plants worthy to occupy the amended soil which he has thus prepared for them.

All the advantages which he has wrought out by a long and laborious series of trials, involving much thought, anxiety, and expense, he freely shares with others. No sooner had he assured himself that his efforts were crowned with success, and calculated to benefit agriculturists in general, than he seeks the best means of making his method known to them, even to the minutest working details. It would have been easy to have secured a monopoly of his implements by that protection which the law affords to original inventions; but the general improvement of agriculture is evidently with him paramount to any consideration of that nature. He seeks no exclusive benefit from his own genius and exertions, but imparts their fruits readily to others. *Non sibi sed patriæ.* Conduct so liberal and disinterested will, we doubt not, elicit a corresponding sentiment of gratitude on the part of those for whose benefit it is intended.

AN ATTEMPT AT AN OUTLINE OF VEGETABLE PATHOLOGY.

By T. LINDLEY KEMP, M.D.

[*Continued from No.* 47.]

SECTION VII. *The Contagious and Epidemic Diseases of Plants.*

A. ACUTE DISEASES IN WHICH THE SYMPTOMS ARE SEVERE, AND RUN MORE OR LESS OF A RAPID COURSE.

I. Epidemic and Contagious Diseases. Diseases that prevail suddenly and extensively run a pretty rapid course, and have a tendency to terminate in putridity or acute degeneration.

It is extremely probable that in the animal world there were for a long time no diseases but acute ones.* Even yet we see that the wild animals almost invariably die either of old age, or of some acute form of disease; and, from what we can learn from history and from observations upon races of mankind in a primitive state, this seems also to have been the case with the human species.† But these early fatal acute diseases do not appear to have been for long

* A chronic disease, it should be observed, is not one that, having been acute, has become chronic, but one the symptoms of which have been chronic from the beginning.

† In the earlier of the books of the Bible the existence of epidemics in towns, or among masses, is often alluded to. Thus Ezekiel says, "They that are in the wastes shall fall by the sword; and him that is in the open fields will I give to the wild beasts to be devoured; and they that be in the forts, and in the caves, shall die of the pestilence."

of an epidemic and contagious nature; indeed, for the existence of these, grouping together in large masses is indispensable. But as soon as we find men congregating together in cities, then we have devastating epidemics. When, too, they began to assemble around them in numbers domesticated animals, these too became liable to analogous affections, and the action of pestilence upon them has been noticed from the very earliest times. The thinly-scattered wild animals are as yet exempted, or nearly so, from epidemics, and the few cases that have been witnessed among them have occurred among those who live in community together.

So, too, it would appear to be the case with plants. Wild vegetables do not suffer from epidemics, inasmuch as numbers of them are rarely in sufficient proximity; and it is only cultivated plants, a great number of the same species of which are put close together upon the same area, that are affected by pestilence. No one ever saw an epidemic among scattered dandelions or groundsels, or nettles; but unfortunately we have all seen or heard of too much of such diseases among our cultivated crops.

Epidemic diseases, then, among plants as well as animals, are in some degree connected with a state that is not exactly primitive, or natural, or savage. This fact may perhaps be of some use in considering their pathology.

Assuming this to be correct, and it is almost perfectly certain, we would naturally expect to find among epidemic diseases, from time to time, new diseases. And this is just what happens. With the very doubtful exception of hydrophobia, there is no instance of any ordinary disease being created since the very beginning of historical medicine. The non-epidemic, acute, and chronic diseases that Hippocrates knew we know, but we know no more. This, however, is very far from being the case with epidemics. Even typhus was probably unknown to the Greeks; small-pox only burst out in the ninth century; and not, as might be done, to multiply other instances, we have in our own times seen created two epidemic diseases—the cholera in man, and the potato disease in that plant. This latter is so important to the agriculturist, and also so interesting to the vegetable pathologist, that it will be considered at greater length than our space will allow us to allot to other diseases. We repeat the definition of the affection from the Nosology.

1. *Potato Disease. An epidemic, and probably also a contagious disease, in which black spots or petechiæ appear upon the stems, and gradually extend to the tubers, and which are followed by putrid degeneration of many of the tubers.*

It is not, it should be premised, invariably the case that the petechiæ first appear upon the stem. On the contrary, the tubers may become affected while the foliage presents a healthy and even

luxuriant appearance. Thus Mr Dudgeon of Spylaw* reported, "The disease may be said to have been so slight, if it prevailed at all, previous to the ordinary season of lifting, that that process was in general well advanced before the discovery of any taint—so much so, that in many cases considerable loss occurred in consequence of ignorance of the disease, no precautions having been used in pitting." And a great many similar instances have been noted. Usually, however, the diseased marks are first witnessed in the stems and leaves. The period of the growth of the plant at which the disease shows itself varies very remarkably, it having been noticed so early as the middle of July, and so late—and that too when the pestilence was very extensive—as October. In some instances, indeed, particularly along the west coast, where sea-weeds are much used as a manure for the potato crop,† it has been thought that the crop has been pitted in a sound state, and that the disease has *commenced* in the pit. In such cases, however, it is more probable that some one or few infected potatoes have been overlooked, and have communicated the contagion to the other potatoes around them, and which other potatoes have probably been remarkably predisposed to take the disease.

The appearance of the marks upon both haulms and tubers is very characteristic. The shaw usually first of all assumes a yellowish and somewhat faded appearance, and then the dark spots appear upon, or rather just under, the surface of the leaves and stems. Sometimes the shaw becomes as if it had been destroyed by frost, and subsequently quite decayed; but at other times its yellow aspect, its spots, and a degree of straggling in its growth, remain until the natural time for it to die. The spots on the tubers begin underneath and on the skin, and are at first of a brownish colour; these gradually extend to the mass of the potato, giving it in the affected portions, as has often been remarked, the appearance of a bruised apple. As the disease advances, the spots become ulcers, having an offensive smell, and a watery or ichory discharge, and ultimately the tuber becomes more or less destroyed and putrid. Occasionally, before proceeding to this last length, the ulceration stops, and a shrivelled dried-up tuber is left, little or not at all suitable for food.

It has been affirmed that the disease commences in the tap-root, but of this there does not seem any sufficient proof.

As there are so many varieties of the potato, it becomes desirable to ascertain if any of these have proved much less liable to the disease than others. Save, however, with the two following apparent exceptions, it does not seem that, when the observation has

* *Transactions of Highland Society*, No. IV., p. 550.

† See afterwards for the probable action of sea-weed as manure as a predisposing cause of potato disease.

extended over some years, any one kind has had any marked superiority in this respect over another. These two exceptions are,—1st, the very early potatoes: for with regard to these, as the disease seldom prevails extensively before the end of August, they are lifted and often consumed before they have time to become much affected; and 2d, kinds imported from secluded places, as was once the case with Orkney reds, &c., that came from places where the disease had scarcely reached, and which, consequently, when imported as seed potatoes into diseased districts, remained healthy until the contagion was applied to them, when they became affected like the rest. Thus the crops which, when the disease first became virulent in this country, were regarded as so hardy and healthy, are now almost annihilated by the malady.

As the natural plan of propagating the potato is (as is the case with all plants that form seeds) from its seeds, and as propagating it as we do, from tubers, is not so much the obtaining new plants as continuing the existence of the old ones, the idea that the potatoes were becoming old, and suffering from the debility of old age, was naturally entertained. But this idea has not proved to be a correct one. Varieties obtained a very little *before the epidemic first appeared, were quite as liable to be attacked as varieties that had been cultivated for a very long time;* new varieties,* obtained from seed after the breaking out of the disease, were as susceptible of the malady as any other kind; † and, indeed, the oldest kinds were occasionally noticed to stand out longest.‡ This last was probably, however, the effect of accident, and in subsequent seasons these old kinds undoubtedly suffered in their turn.

In those cases in which the disease runs its normal course—*i. e.* in which the petechiæ appear first on the leaves and stem, and then extend to the tubers—it becomes an important question how long an interval elapses between the appearance of the spots on the foliage and on the tubers. Sometimes the tubers become simultaneously affected, but generally some days intervene between the two. Thus Mr Campbell § noticed the diseased stem in the first week in August, and the diseased tubers on the 20th of the same month; and Mr Kerr || observed an interval of ten days. On the other hand, a much longer interval sometimes unquestionably occurs. Thus Sir John Richardson writes, "About the *end of August* I discovered the first symptoms of disease in the form of an occasional dead stem and leaves. There had been much rain and a low temperature, and the stems were unusually luxuriant. On examining the tubers at this period, I could discover nothing wrong, and I kept some of them for a couple of months, which continued sound

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* See Report in *Highland Society's Transactions*, frequently.
† See numerous instances in *Highland Society's Transactions*, No. XIV.
‡ Ibid., p. 541, &c. § Ibid., p. 460. || Ibid., p. 510.

even after being cut into halves. I observed nothing peculiar about the flowers, and the apples were generally well ripened, which I have proved by raising a large quantity of young plants from the seed. It was the *beginning* of *October* before the fields in this neighbourhood were discovered to be generally affected, and at this period the brown gangrene under the skin was perceived." * Colonel Macdowall observed even a longer interval still; he says: "*July.* I first observed the plant affected partially, the stem drawn up and dwindled, leaves not expanded, the seed at root moist and decayed. *October.* Observed the new tubers affected, but not generally; a slight brown mark like a bruise on an apple, increasing rapidly when pitted, when whole pits are destroyed in a few days." † In this last case the plant was affected with the disease before tubers were formed, and yet had sufficient vigour left to form them.

The disease has occurred in almost every possible variety of soil, and therefore soil is not a cause of the disease. But certain soils certainly predispose to its greater extension. A damp clay, and, indeed, a damp soil of any kind, unquestionably promote its progress. "Wet soils," says Mr Darling of Northumberland, "were decidedly most severely affected; and in many places on *high gravelly and sandy* land no perceptible loss has been sustained, and much good seed is now available from such sources." Abundance of evidence of the disease being more prevalent on wet land might be brought forward, but the fact is, we believe, admitted. It is also equally certain that the disease has often at least, and generally, apparently as a rule, been more extensive and more virulent upon highly farmed land—*i. e.* land from which large crops have been annually taken, and the waste repaired by large supplies, principally of farmyard manure and of guano. Thus Mr Gordon ‡ reported, "Wherever the land was in the highest state of cultivation, and the crop heaviest, there was scarcely a possibility of preserving them (*i. e.* the potatoes). The same remarks apply equally to all sorts of soil in a high state of cultivation." Mr Burnet § says, "The disease has prevailed most upon wet heavy land, and even on drained land, if of a strong nature, more particularly when the land was naturally rich or highly manured." Mr Lade ‖ writes, "Where soils have been highly cultivated, the disease was worse." Mr Gardner ¶ observes, "Upon all the best cultivated and richest manured lands, the potato crops of last year suffered most." A great amount of similar evidence might be produced, but perhaps enough has been said to establish the fact. Indeed, the reason that the disease is so virulent in gardens is only explicable by this cause.

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* See *Highland Society's Transactions*, No. XIV. p. 538. † Ibid., p. 545.
‡ Ibid., p. 465. § Ibid., p. 471. ‖ Ibid., p. 472. ¶ Ibid., p. 547.

On the other hand, there are certain conditions of soil that are very unfavourable to the propagation and extensive spread of the disease. The contagious and epidemic nature of the malady is indeed so potent, that even in potatoes growing in these favourable soils the disease is set up, but often with comparative impunity, and but little mischief is done. Potatoes grown in peat or moss, *i. e.* land rich in vegetable matter, are very indisposed to become severely affected. Thus Mr Campbell, Craignish,* reports, "The only potatoes that entirely escaped the disease in June were grown on dry moss near the sea-shore." Mr Kennedy† says, "It is of much importance, also, to notice that potatoes grown in moss land have been generally free of the malady." "I had," writes Mr Mitchell,‡ "the end of a field of mossy land that was not rank, but in a forward state; they escaped the disease altogether: but the other end of the field was very bad." Mr Bruce of Prestonkirk,§ in East Lothian, states, "They were planted both on wet and naturally dry soil, but suffered equally with the exception of a small spot very mossy, which escaped comparatively free." "Peaty soil," says Mr Ewart of Perthshire,‖ "suffered least, and those of the purest moss were decidedly soundest." Were it necessary, plenty more analogous evidence might be adduced.

The other kind of soil that has appeared not to favour the spread of the potato disease, is that found in the valleys of granite countries, and which has not been severely, or, indeed, much subjected to arable culture. Districts such as these at first resisted the disease altogether. Thus, in 1846, the late Captain Barclay¶ reported, "Happily this county, Kincardine, has been almost entirely exempt from such a calamity, and in this immediate neighbourhood the potatoes were even of finer quality. I have made particular inquiry among the farmers of this county, and find there is nothing to complain of; and such I understand to be the case with all the northern (north-eastern ?) counties." Indeed, save along the banks of rivers, and where arable culture has been systematically and extensively carried out in these granitic valleys, the field potatoes have rarely been much diseased, although those grown in the proprietors' gardens in these localities have been as bad as elsewhere.

Vicissitudes of climate have naturally been applied, to explain the cause of the disease; but it may be safely affirmed that the disease has prevailed, and prevailed extensively in this country, in heat, cold, rain, drought, and every possible atmospherical contingency that is appreciable to the meteorologist. The only exception perhaps is, and that when the disease has fairly begun, that long-continued rain has seemed to promote its spread.

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* See *Highland Society's Transactions,* No. XIV., p. 466. † Ibid., p. 468.
‡ Ibid., p. 470. § Ibid., p. 514. ‖ Ibid., p. 515. ¶ Ibid., p. 534.

Several insects have been noticed about potatoes suffering from the disease. The most frequent of these are, *botrytis infestans*, *aphis vastator*, *noctua exclamationis*, *mytilus nitidatus*, and *litholens forficatus*. Notwithstanding strong assertions to the contrary, it may be pretty confidently affirmed that all these are accidental attendants upon the disease.

Fewer experiments have been made by inoculating healthy potatoes with diseased ones than is desirable. The fluid contained in the spots cannot probably produce the infection, this dark liquid not being the morbid matter itself, but the devitalised, or partly devitalised sap, which has lost its vital properties owing to the morbid action going on. Mr Gorrie probably succeeded in making the disease pass from cut diseased potatoes to cut sound ones, when the two were put into contact. Professor Vrolik, of Amsterdam, gives as the results of his experiments (but we are not aware of the exact nature of these experiments), "that when the diseased tissue of a rotten tuber is transferred upon wounded sound potatoes, a degeneration of the latter becomes clearly perceptible after eight or more days." *

Notwithstanding the disease often attacks so large a number of plants at nearly the same time, and is therefore clearly excited by some probably atmospherical but unknown cause, there is little doubt but that it is also propagated by contagion. All the conditions mentioned in Section VI., in this respect, seem to be amply present.

With regard to the chemistry of a diseased potato, our information is not very exact.† The proportion of water, contrary to the general impression, is little affected. The statements that are made regarding the alteration of the proportion of the saccharine and albuminous proximate principles, are perhaps rather too vague for much reliance to be placed upon them. When a diseased (*i. e.* a partially diseased) potato is boiled, the diseased portion often comes out as a hard roundish lump; but these lumps have not, we think, been analysed. All this, however, is of little consequence, for all that chemistry can do is, to tell us the composition of the morbid product that has been formed, and nothing of the nature of the action, or the series of actions, that have produced it.

The potato disease certainly prevailed endemically many years before it became so violently epidemic. In North America it more than once committed great ravages, before it was ever heard of in this country. In Mull, too, and other of the Hebrides, it was also very bad several years ago. Indeed, as far as we know, at least as far as regards the British empire, it was in these two localities that the disease originated. It will be seen by-and-by that this has

* *Quarterly Journal of Agriculture*, No. XIII., p. 349.

† See Fromberg on this subject, in No. XVI. of *Quarterly Journal of Agriculture*, and his conclusions, at p. 698 of same.

perhaps an important bearing upon its pathology. The disease may, perhaps, be said to have become a widespread epidemic in Great Britain in 1844.

Before attempting to consider the pathology of the disease, it may be useful to notice some ascertained facts regarding that animal affection that is so analogous to it,—typhus fever.

Typhus, like potato disease, is a virulent epidemic; it certainly, as potato disease probably, is propagated by means of contagion; and the result of the morbid actions that constitute them is to produce putrid degenerations of the structures of the affected animals and plants, and in many cases death. Further, with regard to typhus, it is ascertained that the most important practical matter about it is its *predisposing* cause or causes. Let the epidemic influence be strong, and the contagion concentrated, it does not prevail much unless these predisposing causes are present likewise.

These predisposing causes are, fortunately, now pretty well understood. Anything, in fact, that depresses the mental system, and lowers the strength of the circulation, is a predisposing cause to typhus; and any one having his circulation in a weak state, and who is exposed to the contagion, is almost sure to take the disease, and *vice versâ*. But in actual practice it is found that the great debilitating cause that produces this weakened state of the circulation, and the consequent predisposition to typhus, is the more or less continued (for some time) deprivation of one of the proximate principles essential to wholesome food; and it has been found that the proximate principles that have been deficient in typhus patients have been albuminous ones.

In fact, whenever, from short crops, deficient employment, &c., the masses have not duly received a due supply of nitrogen, debility of the circulation has been produced, and great numbers of the individuals thus weakened in this respect, invariably catch typhus if they are exposed to its contagion, and also convey the contagion and the disease to others similarly dibilitated. It appears, indeed, in the animal world, to be a provision of nature, that when food is scarce, typhus is predisposed to, in order to reduce the population to the limit of the food, and thus prevent annihilation. That defective food strongly predisposes to typhus is now so well known that physicians can now tolerably accurately anticipate each outburst of typhus.

Potatoes certainly have not had an insufficient supply of nitrogen, for they have received large applications of farmyard manure and guano, both very rich in this element; but for many years the large quantity—the very large quantity—of potassa properly necessary for their healthy structure, must have been with difficulty obtained, and indeed very often not obtained at all. Of all the ingredients in ordinary soil, potassa exists in the smallest quantity; and were the amount of it estimated at 1 in the 100 parts, it would be a

great exaggeration. And yet a farmer who every year grows five acres of potatoes, assuming that each acre yields eight tons, must be able, if he raise a sound and rightly constituted crop, to extract from his soil one thousand two hundred and sixty-five pounds of potassa. Of this he returns in the haulms two hundred and fifty pounds to his land, leaving one thousand two hundred and fifteen pounds of this scarce commodity to be annually sent off his farm. And he does not make up one single pound of this expenditure from without, for the guano that he trusts to as a foreign supply contains none. The wonder is not that the potato has become impoverished in its sap, weakened in its constitution, and therefore liable to take epidemic disease as much as it does, but that it has not been more diseased or entirely destroyed.

It will be observed that this explanation or account of the pathology of potato disease exactly agrees with all the above-mentioned facts that have been stated regarding it. It began in North America, and in Mull and other Hebridean islands. In the former of these localities it is a matter of notoriety that the potassa has been extracted from the soil by timber, the timber burnt, and the black ashes or potassa exported. In the latter, potatoes were raised year after year on the same ground, the manure used being sea-weed, that contains no potassa. If it be true that debility is the predisposing (and therefore the efficient) cause of the potato disease, and that this debility is produced by an imperfect supply of potassa, these two localities are the very spots for the disease to first show itself. Then the disease is worse on wet soils, and in these, for an obvious reason, what little potassa there is, is with greater difficulty obtained by the plant; and is not so bad in light and dry ones, where whatever potassa is present may be more readily assimilated. But it is much less prevalent in mossy and peaty soils, the very soils and the only soils that really contain an excess of potassa. So also in well-cultivated arable land it is worse, for such land is peculiarly deficient in potassa, the cereal grains grown upon them carrying off so much of this alkali to towns. But in granitic valleys the disease is again checked, and it happens that the felspar of the granite which, when disintegrated, makes up a great part of such soils, is uncommonly rich in potassa. However, in severely cropped land, and in gardens on these granitic soils, the disease again prevails; and we know that in both these cases the potassa must have been very much diminished.

The conclusion that may legitimately be come to, seems to be this,—the exciting cause of potato disease is an epidemic influence, and perhaps also a contagious miasm; and it attacks potato plants that are in a state of debility—this debility being caused by the plants having received, for a succession of years, a very imperfect supply of potassa, a substance which is to the potato an ingredient absolutely necessary to its healthy structure.

This is a paper on pathology, and has therefore nothing to do with the cure or prevention of disease; but it may perhaps be here stated, that, if the above conclusions are true, the remedy for potato disease is the careful growing of the seed potatoes for many years in land where, besides the other ingredients of which they stand in need, they will have an ample supply of potassa.

2. *Potato Curl. A disease in potatoes, apparently propagated by contagion, in which the plants in many parts of a field or patch become rapidly and successively curled, and a little after this the tubers become shrivelled up.*

The curl is a disease among potatoes that prevailed very extensively, and did a good deal of injury to the crop, during the last half of the past century and the beginning of this. Now, however, it is comparatively rarely seen. The reason of the present immunity from it seems to be the greater care that is now taken in storing potatoes. Until within a few years past, the greatest carelessness generally prevailed in keeping the potatoes over winter. All the tubers, healthy or not, were shovelled into a hole in the ground, and protected from frost; and when spring came, what were left were pretty promiscuously taken for seed. As the curl is a decidedly contagious disease, and as few potato-pits in these times did not contain some curled tubers, the disease was naturally perpetuated from year to year. Since greater care has been taken in storing potatoes, and only apparently quite healthy ones pitted, the disease has almost disappeared. In this respect it bears a great resemblance to plague, which has, by means of quarantine regulations, been kept away from this country for about two centuries, although ships from infected ports have been, and are continually, entering our harbours.

The disease in question is known by the curl that takes place early in the season in the leaves, and the tubers in the curled plants are uniformly found waxy and unwholesome. If one plant in a patch becomes curled, the disease tends to spread successively to other ones, and there can be no doubt of the contagious nature of the affection. Of the nature of the contagion, or of the disease itself, we know nothing, any more than physicians know anything of the nature of the contagion of measles, or of the nature of that disease itself.

Two causes have been assigned to it. One is, that it is produced by over-ripeness in the sets. This was maintained first by Dickson.* He employed, for his sets, cuts from the waxy or least ripened end of a ripe potato, and reported that he escaped the disease. Mr Crichton† also employed immature tubers for seed, and he likewise evaded the disease. Young ‡ confirmed these two statements.

* *Caledonian Horticultural Memoirs*, i. 55. † Ibid., p. 440. ‡ Ibid., iii. 278.

But it may be affirmed that the phrase over-ripeness, as applied to a potato, really means nothing. In fact, there is no such thing. A ripe potato is one with its full amount of starch, and such is in its very best condition; and, moreover, a potato never has more than its proper complement of starch. That one end of a properly-grown potato is materially less ripe than the other, is, too, very doubtful. Besides, other experienced cultivators have observed the very opposite result from that reported by the fore-mentioned authorities. Thus Rogers* remarks, "The author has tried many of the supposed preventions, but found none better than always planting *with ripened* sets." The reason, probably, that Messrs Dickson, &c., avoided the curl was, that, although they selected the seed for another cause, yet they did not employ for seed, potatoes actually affected with the curl.

The other supposed cause is that of Mr Sheriff,† who maintained that the potatoes were, from the manner in which they were perpetuated, becoming old, and that curl was an affection of their worn-out condition. The fact that curl has nearly disappeared effectually disproves this.

3. *Vine Disease.* (The definition of this is again postponed until the next Number.)

The consideration of the pathology of this important and extensively-spread disease is also postponed until the next Number. The following account from Mr Harris may here be quoted, without, however, the writer of this paper being committed by any opinion expressed in it.‡

"The grapes, when blighted, are covered with what appears a white powder, like lime, a little darkened with brown and yellow. These fungi send forth laterally, in all directions, thread-like filaments, which become so completely interwoven with one another as entirely to cover and enclose the skin of the grape in a compact and firm net-work, and on each are seen the egg-shaped capsule, or seed-pod. The pips and juice go on swelling, and at times, when struck late in the season, the grapes become partially ripe and coloured. But very soon, expansion from within going on, checked with this net-work, the grape bursts; but as it cannot burst as it should do, were it unconfined, the edges of the part where it bursts turn inward in place of outward, and the pips are exposed to view as the teeth of a man when his lips are drawn back. If the grapes are attacked in an early stage of their growth, they dry up, fall off, and become very offensive, but do not split."

* *Vegetable Cultivator*, p. 250. † *Caledonian Horticultural Memoirs*, i. 60.

‡ The reason that the consideration of the vine disease is postponed is, that the author has not yet been able to procure and peruse the reports recently made on the subject in France.

4. *Pestilence. This is a vague term, and intended to include those sudden and apparently contagious diseases of cereal grains that seem to have been epidemic in Europe in the Middle Ages.*

It is impossible to attempt any account of these pestilences that seem to have been so common in early and medieval times, for we have really no evidence beyond the simple statement that they occurred. They would seem to have been epidemical diseases, excited probably by contagion and predisposed to by debility, brought on from want of sufficient food in the ground. That this should have been the case in medieval times, we can, when we consider the culture employed, easily imagine. The cultivation of the outfield, from the lawlessness and barbarism of the Middle Ages, seems to have been very unprofitable. He who sowed the crop had not more chance of reaping it than to induce him to lay out the seed, and no manure was applied to outfield crops. After a time these outfields would grow no more, and then they were allowed to fallow for years. But before they became absolutely unproductive they must have afforded sickly and debilitated crops, just such as we know would yield at once to contagion if applied to them.

The cultivation of the arable infield near to the feudal village was something, but not very much, better. It was cropped year after year with the same cereal grain, and very imperfectly manured. This, of course, induced weakness and consequent liability to catch contagious diseases.

One of the earliest of these recorded vegetable pestilences is probably the Egyptian one recorded in Genesis. In Rome, one occurred early in the kingdom. It is recorded by Zonaras,* who particularly notices the *sterilitas agrorum*. It was, however, during the Middle Ages that these visitations appear to have been most prevalent. In 820,† France was visited with a severe one. In 851 there was one in Scotland, that caused a pestilence and famine among the human inhabitants. In 968 there was a general disease in the corn crops. ‡ In 1105 there was another; and, indeed, some such appear to have occurred every few years. In 1368 the crops in England seem to have failed almost altogether, and the consequent want of food predisposed to the great plague that ravaged the island in the reign of Edward III.§

It is unnecessary to state any more dates at which these pestilences occurred among the crops. They were exceedingly common, and produced much human suffering; but of their exact nature we know little or nothing, and the causes that produced them appear to be now far less active and intense.

[*To be concluded in the next.*]

* Lib. VII. † Magd. Cent., 9, 13. ‡ Ibid. 9, 13.

§ The annalists who describe these vegetable pestilences very frequently remark that the domestic fowls took to the woods, the corn being apparently so scarce that none could be afforded to them.

THE COMMERCIAL PRODUCTS OF THE HOG.

By P. L. SIMMONDS, Author of "The Commercial Products of the Vegetable Kingdom," &c. &c.

It has been well observed that there are few things in which the public have so great and general an interest, and concerning which they possess so little real knowledge, as of the provision trade, and the wholesale traffic in animals, live and dead, in their own and in other countries. When, where, and how raised, and what processes meat passes through before it reaches their tables, are questions which, though highly important, are very seldom asked by the consumers—all that they usually trouble themselves with is, the current retail price and the nature of the supply. I purpose in the present paper to investigate the products of one of the domestic animals—and that usually a depreciated one—the hog; with the object of showing how large is the extent of the trade in its flesh and products, and how rapidly it has increased within a very recent period.

Mr Ormandy, a functionary of the North-western Railway, in a summary of the cattle traffic on all the lines of railway in the United Kingdom in 1853, furnished the following figures as regards pigs as "travellers": —

England,	704,037
Ireland,	223,499
Scotland,	28,022
Making a total of,	955,558

Whether these figures embrace the small fry of "sucking" pigs is not stated; but these innocents, I believe, invariably come to market in the slaughtered state. The proportion of the traffic to the whole number, in the absence of general statistics, it is impossible to compute, but in Ireland the proportion carried was 1 in $4\frac{3}{4}$. The number of pigs brought into Liverpool in 1852 was 116,504 from Ireland, and 6316 coastwise; there were also 10,539 foreign pigs imported into our ports that year. The number slaughtered in Liverpool annually is about 29,000. In 1846, the immense number of 480,827 pigs was received at Liverpool from Ireland, valued at £1,500,000.

The imports of pork into Liverpool in the year ending October 1, 1853, amounted to 38,164 barrels, of which 10,500 barrels were received from America and Canada, 16,000 barrels fr**ô**m France, and 11,500 from Ireland. The imports of bacon were 118,906 cwt.; of hams, 10,597 cwt.; and of lard, 4756 tons.

In 1854, January to December, the total receipts of pork were 33,611 barrels; of bacon, 226,492 cwt.

The value of the trade in the commercial products of the hog at Liverpool alone last year may be thus stated:—

VALUE OF THE IMPORTS.

33,611 barrels of pork, 200 lb. average, at say 70s. per barrel,	£127,638
226,492 cwt. bacon, at 40s., ...	452,984
11,585 tons of lard, at 52s., ...	601,780
17,000 cwt. of hams, at 42s. per cwt., . . .	35,700
120,000 live pigs, at £1 per cwt., . . .	120,000
	£1,338,102

The number of pigs sold in Smithfield market yearly is now about 96,000; but a great deal of pork comes up to the principal meat markets of the metropolis ready killed. From careful inquiries I have made, I assume it at 115,000 stones of pork to Newgate market, 550,000 stones of pork and 28,000 sucking pigs to Leadenhall market, and 150,000 stones to Whitechapel.

The following figures show the numbers slaughtered at some of the principal towns yearly:—

Glasgow, in 1852, ...	5212 pigs.
Wolverhampton, in 1850, ...	34,000 „
Manchester, in 1850, ...	40,650 „

The statistics of swine raised in various countries it is of course scarcely possible to obtain with any degree of accuracy, for the numbers necessarily vary year by year according as there is an abundance or scarcity of suitable food for them, and as there may be a local demand for consumption arising from increase of population, or for export, owing to enhanced prices abroad, &c. In 1847, Great Britain had about 700,000 pigs; in 1851, rather over 1,500,000; and at present the number is estimated at fully 2,000,000. Of this number Ireland has a large proportion, and Scotland scarcely 200,000.

In the United States, in 1850, there were by the census returns 30,315,719 swine. The proportion of pigs to cows there was as 5 to 1, and of pigs to sheep as 10 to 7. From the Patent Office Report for 1853, it seems the number then was estimated at 32,000,000, valued at 160,000,000 dollars, or about £32,000,000 sterling. The number of swine in the United States now may be fairly set down at 40,000,000, or more than all the states of Europe combined.

In Western Canada, in 1851, the number of pigs was given at 569,257, and the number of barrels of pork cured at 310,058.

It is somewhat difficult to obtain any reliable returns respecting the European states, but from the inquiries I have set on foot, it would seem that the Austrian empire has about 5,500,000 swine,

and Austrian Italy 250,000. Finland had, in 1852, 204,000, and Norway about 100,000. France has at least 5,000,000 or 6,000,000 swine; indeed, this is about the number stated to be slaughtered annually in that empire.

The Australian colonists do not pay much attention to the rearing of pigs, with the exception, perhaps, of New Zealand and Van Diemen's Land. In the latter island the number may be about 30,000; in South Australia, about 12,000; and in Victoria, 9,000. New South Wales has about 80,000 head, and there are a few kept in Western Australia.

At Mauritius and in the Cape Colony the number of swine is proportionately large, numbering about 30,000 in the former island and its dependencies, and probably 200,000 in the various Cape districts and settlements.

The Lower British American colonies may be estimated, according to former returns, to contain at present the following:—

New Brunswick,	80,000
Nova Scotia and Cape Breton,	100,000
Prince Edward Island,	36,000
Newfoundland and Labrador,	30,000
	246,000

A comparatively small number, certainly, for these provinces.

Russia must possess immense herds of wild hogs, but then they are mere animals of skin and bone, roaming through the forests, deserts, and wastes, and deteriorating from the vicissitudes of the climate. The wild boars of Barbary, Bengal, and Scinde, are said to be much finer animals than those which endure the severity of a northern winter in the forests of Germany. The extremes of domestic swine, observes Mr Gisborne (*Essays on Agriculture*), are Prince Albert's prize pig at the one end, and the pig whose domestic hearth is in the hut of the Finn, all the way from St Petersburg to Archangel, at the other. From the appearance of the Russian pig you would not suppose he had any vitals—there seems to be no room for them. His bristles, if not his ornaments, are at least his distinction. He furnishes them to our markets to an extent, both in quantity and value, which, but for custom-house statistics, would be thought fabulous.

Bristles were formerly a large item of export from Russia to England and America, ranging from 2½ to 3 million pounds' weight annually; but both countries have learned to be more independent of these supplies, for the United States now obtain a considerable quantity at home, and the strong vegetable bristles obtained from the kittool fibre, furnished by a species of palm in Ceylon, enters largely into the manufacture of brushes of all kinds; even our metal manufacturers have furnished a substitute in beautiful,

flexible, and durable galvanised-wire brushes, available for hair, flesh, or clothes brushes. Shoemakers and saddlers must, however, still look solely to the bristles of the wild boar; and as it is not a bulky article of transport, 500 to 1000 tons of bristles may probably still reach this country through Prussia and other neutral ports.

The nature of the food of the hog has, of course, a great effect upon the commercial value of the flesh. In our own forests, acorns and beech-nuts form a considerable portion of the food of the Hampshire hogs; but "mast" fed bacon in America is considered to want that firmness and quality which is characteristic of those fattened on maize. Pigs which roam at large about towns and the sea-shores, feeding on fish, sea-weed, and garbage, are usually vile-looking, lean, long-snouted animals, scarcely fit for human food. In the River Plate, we are even told that herds of swine have been fed on mutton, the carcass of the sheep being there useless. In some of the whisky distilleries on the Ohio they keep large herds of 7000 to 9000 hogs, which are fed upon the grain. At certain seasons of the year, from the character of the food, or from other causes, epidemics prevail among the swine. In the last two years, 12,000 hogs died at the two largest distilleries at New Richmond, about twenty miles from Cincinnati. These hogs were, however, not a total loss, for 450 barrels of lard oil were obtained from their carcasses. In many of the American states, apples form a principal portion of their food, and the "apple sauce" thus becomes incorporated with the flesh.

In British India, only Europeans and the low Hindoos eat pork, but wild hogs are very abundant, and afford good sport to the hunter. This avoidance of pork arises as much from religious scruples as the deep-rooted aversion to the swine all must imbibe who have only seen it in the East, where it is a tall, gaunt, half-famished, and half-ferocious-looking brute, which performs the office of scavenger.

The Chinese are passionately fond of pork, and have a very fine race of pigs, of which we have profited as a cross to our native breeds. When the Chinese cannot procure pork, they dress up puppies to meet the existing demand. One of the most profitable sources of revenue of the Peninsular and Oriental Company's steamers on the Canton river is towing up boat-loads of pigs for the celestial epicures of the capital. To such an extent is this traffic carried on throughout the East, that the last official *Boletin* of the Macao government, which I have received by the overland mail, contains in detail an important "Contract for the exclusive Sale of Pork within the City of Macao from the 1st of March of 1855 to the end of February 1856." The following are the terms:—

"The Worshipful Company of Porqueiros (Pork-butchers), by their Agents, Cam-chom-quim and Tau-can, bought at Public outcry, on the 16th of January, the exclusive right to sell Pork for one year (as above) at the rate of 3300 dols. (L.660), payable quarterly in advance, for which payment the Chinese Tai-ché is guarantee."

The conditions are then stated :—

1st. The Contractors shall supply the market with Pork for consumption at the prices marked in the schedule—the weight to be 16 taels to a catty ; the scales to be tested at the Custom-house. Should there be a difference in the scales, a fine of 5 taels to be imposed for the first offence, and ten taels for the second ; half of such fine to go to the denunciator, the rest to the public chest.

2d. Any person found selling pork without the appointment and permission of the Contractors to be fined ten taels for the first offence, and twenty for the second, together with 30 days' imprisonment. The fines to be divided as before prescribed.

3d. Importers of live pigs for sale, without the license of the Contractors, to be fined as in preceding section, and pigs to be confiscated. Care is to be taken that importers of pigs are not imposed on by the Contractors.

4th. Contractors and their Agents may not use improper means to make the meat weigh heavy, under pain of the penalty stated in article 1.

5th. Pigs may be kept in the city by citizens *for their own use*, but may not be traded in without Contractors' license, under penalty described in article 2. A license to sell pig may be obtained of the Contractors on payment of 2 mace of silver (about a shilling).

Schedule of Prices at which Pork is to be retailed.

Loin and ribs,	9 catties and 14 taels per dollar.
Leg,	10 catties "
Fat,	14½ " "
Flank,	11½ " "
Lard,	12 " "
Head and feet,	13½ " "
Tongue and heart,	12 " "
Other parts,	prices current.

These rates may be taken at an average of 3d. and 4d. per lb., but in Hong-Kong the prices are 100 per cent higher.

They are too thrifty in China to kill their pigs when sucklings, and they are therefore allowed to reach a mature age before becoming martyrs to the knife. They usually roast the hog whole, and itinerant vendors carry about the pig, disposing of slices or joints to customers.

In warm countries, pork is apt to promote scrofula, dyspepsia, and other disorders of the system. The Jews, Turks, Arabians, and others who observe the precept of avoiding swine's flesh, are certainly more free from many gross diseases than the Christians. The Romans, M. Soyer tells us, were especially a pig-eating race, and retained their fondness for pork from the foundation to the decline of their empire. They discovered fifty different flavours in pork, and, under the hands of their skilful cooks, swine's flesh was often transformed into delicate fish, ducks, turtle doves, or capons. The pork consumed in the United States is three times the quantity consumed by an equal number in Europe.

Pork is also the great food of the Brazilian people. It is prepared, according to Dr Walsh, in a peculiar manner. When

the pig is killed, the butcher dexterously scoops out the bones and flesh, leaving behind only the covering of fat. In this state it is salted, folded up, and sent in great quantities to Rio Janeiro, where it is called *toucinho*. All the stores and *vendas* are full of it, and it is used commonly for culinary purposes, and forms an ingredient in every Brazilian article of cookery.

Bullock (*Travels in* 1829) tells us that the Mexicans are very curious in rearing and feeding swine, and that an essential requisite in a Mexican swineherd is an agreeable voice, in order that he may sing or charm the animals into peace when they quarrel and fight, and lull them to sleep at proper times to promote their fatting!

Large droves of pigs migrate annually into Hungary from Servia, where they still live in a half-wild state. They fatten in the extensive oak forests, and are sent to market in the large towns, even to Vienna, and still farther. The task of driving the animals is shared by the kanasz or swineherd (several of whom have to attend each drove), his dog, and his ass. The jackass heads the drove, bearing a large bell round his neck, like the bell-wether of a flock, and carrying the provisions of the driver on his back. The dogs, of a handsome and strong race, called the white Hungarian wolf-dog, run incessantly round and round the drove, and keep the pigs together. Whenever the kanasz wishes to rest, he makes a signal to the dogs, when they fasten and hang upon the ears of the jackass, so that he can proceed no farther, but stands there with his uncomfortable ear-drops and his woe-begone face, a veritable picture of misery. The hogs find food in profusion in these luxuriant oak forests, and commonly stuff themselves to such a degree that they lose all desire for roving about; so that dog, master, and ass lead a comparatively easy life, and are left to the quiet enjoyment of nature.*

In America they speak of the crop of hogs as other countries do of their sugar, coffee, and general exportable staple crops; and even when packed and cured, they occasionally compute the produce by the "acre." Thus the *Louisville Courier* stated recently, that there were five or six *acres* of barrelled pork, piled up three tiers high, in open lots, and not less than six acres more not packed, which would make eighteen acres of barrels if laid side by side, exclusive of lard in barrels, and pork bulked down in the curing-houses, sheds, &c. Besides the above slaughtered hogs, there were five or six acres more of live hogs in pens, waiting their destiny. The crop of hogs in the Western States in the season of 1852, was

* SCHLESINGER'S *War in Hungary.*

estimated at 1,300,000, averaging 200 lb., equal to 260,000,000 lb., and they were thus apportioned;—

	Pounds.
2,600,000 hams at 15 lb. each, . . .	39,000,000
2,600,000 shoulders at 16 lb. each, . . .	41,600,000
25 lb. leaf lard to a hog, at 220 lb. to the barrel, 147,727 barrels, or, ...	32,500,000
8 lb. rump to a hog, at 200 lb. to the barrel, 52,000 barrels, or, ...	10,400,000
70 lb. side meat to a hog at 200 lb. to the barrel, 455,000 barrels, or	91,000,000
25 lb. head and feet, ...	32,500,000
10 lb. wastage, ...	13,000,000
	260,000,000

—*Cincinnati paper.*

In the Western States we see, then, that pork is the great idea, and the largest owner of pigs the hero of the prairie. What coal has been to England, wheat to the Nile, gold to California, and sheep to the squatting interests of Australia, pork has been to the West in America.

The States of Ohio, Kentucky, Indiana, and Illinois are the great marts in which the slaughtering of hogs and pickling of pork for exportation are carried on. The greatest depots are Cincinnati, where about 500,000 are now slaughtered yearly. Louisville, Madison, Hamilton, and various other places furnish their quota of 50,000 to 70,000 each. There are about sixty towns in which this branch of business is largely carried on.

The number of hogs slaughtered and packed in Cincinnati last year (1854), was 431,000, being nearly equal to the number in 1848, which was 475,000; estimating these at 208 lb. average, the actual cost at 4 dols. 47 cents per 100 lb. would be 4,008,300 dols. Reduced into pounds, the whole pork crop of last year may be stated at 533,992,850 lb. The increase in number is a fraction over 15 per cent on the previous year's aggregate, and in pounds the product shows an increase of 22½ per cent.

HOGS PACKED IN THE WESTERN STATES.

	1850-51.	1851-52.	1852-53.
Ohio, ...	363,464	547,343	603,152
Indiana, . . .	182,549	447,352	500,945
Illinois, . . .	168,870	231,519	324,856
Iowa, ...	55,000	40,500	52,652
Missouri, . . .	102,000	69,436	87,200
Kentucky, . . .	205,914	205,600	338,300
Tennessee, . . .	3,600	10,000	36,500
Michigan, . . .	...	10,800	10,400

The price of pork has run up considerably at Cincinnati, having advanced from about 3 dollars per 100 lb. in 1849-50, to 6½ dollars

in 1852-53. Pork, which only fetched 38s. to 44s. per barrel of 200 lb. at Liverpool in the close of 1843, ran up to 83s. to 85s. in December 1852, stood at 60s. to 76s. in December 1853, and is now, May 1855, at 75s. to 82s. 6d. per barrel. The Government contracts for pork for the navy in September were nearly double in amount those taken in the previous year, and at greatly enhanced prices. The contract in 1853 was for 9000 tierces of 320 lb. each, at £7, 17s. 6d., and 2700 barrels of 208 lb. at £5, 2s. 6d. In 1854, the contract was for 17,000 tierces at £9, 19s., and 3500 barrels at £6, 19s.

The following graphic account of the system of slaughtering hogs in the butchering-houses in Cincinnati is from a Western American paper :—

Aside from the prodigious number of hogs, cattle, sheep, and calves disposed of, there is an interest in watching the machine-like order of the work. The butcher's yard and building is, of course, not a neat place, while the blood and offal of two thousand hogs a-day pass through them. The slaughter-house is situated in some retired hollow, with a small stream passing beneath it, and is generally a cheap temporary building. The hogs of each drove are kept in a separate pen till the hour of execution, when a devoted few, say thirty or forty, are compelled, much against their will, to march up a platform within the building. Here a man with an iron sledge goes among them, and strikes them on the head with a dull, sickening sound, and they fall without a squeal. While in a senseless state they are thrown upon a grating near the scalding-vats, where they are stuck, and the blood flows into the stream below. The vats are wide enough to place a hog crosswise ; and there are, in large establishments, two vats, on each side of which are five or six men, making twenty in all. The water is kept hot by steam, and the carcasses are constantly kept turning and stirring as they pass along, so that when they reach the further end of the vat they are stripped of the hair, and are hauled out and hung up by the heels for gutting. The man who strikes them puts a mark on the leg of each, to show who is the owner. A hog is pushed from the grating all quivering and bloody, into the scalding water, about once in half a minute, and a clean carcass is hauled out of the other end of the vat as frequently, and also another taken from the gambrel and carried to the hooks as often, where he hangs till the next morning to cool. For two vats about fifty men are required. The next morning a four or six horse team appears at the slaughter-house, bright and early, and piling the stiff carcasses into a huge rack, conveys them to the packers. The *butcher,* instead of being *paid* for his expense, pays the *drover* something—eight, ten, or twelve cents a-head—for the chance ; and all the offal belongs to him, including everything taken from the animal. At the packer's, which is in a more public part of the city, the hog is weighed, and two men place his body on a bench. On each side of the bench stand two strong men, with huge cleavers, more dreadful than an executioner's axe, on which they put a keen edge between each blow. One blow, given simultaneously by each, severs the head and also the hind quarters from the trunk. These are thrown in different directions to be trimmed and cured. One of the cutters turns the trunk on its back and holds it open while the other splits it along the backbone. Each one takes half, and the leaf lard being torn out, he cuts off the shoulders, and at four strokes the sides are cut into the proper form. The hog disappears in different directions, and in about half a minute from the time he was put upon the bench, another takes his place to undergo the same process. The pieces destined for mess pork are salted into a barrel, headed up, filled with brine, rolled into the street, put on a dray, carried to the river, and the hog may be on his way to New Orleans, as pork, within twenty-four hours after he crossed the ferry from Kentucky.

The western producers commence packing pork for the New

York market about the 1st October, and finish about the 1st December following, so that it has nearly all arrived before the inland navigation is closed by the ice. They commence repacking the pork in New York the latter end of November, and end about the middle of January. Pork *via* New Orleans arrives at New York from about the middle of January to late in the spring, while those who depend upon canal carriage commence shipping as soon as the canals are open, and thus shipments come to hand in New York in July. The Erie railroad brings down hundreds of hogs to New York almost every day in the year.

There is a large business carried on in pork curing and packing in New York, from hogs fattened in that State, in New Jersey, and also in the Far West. During warm weather the business of curing and packing is done in ice-houses, and during cold weather in yards. The quantity (according to a careful estimate) cured and packed in the city of New York during 1852 was 31,250,000 lb. It is generally packed in barrels which contain 200 lb. each. Although the producer is not bound by law to submit his produce to inspection, still there is but a small quantity cured that does not receive the inspector's brand, as it has been found more profitable and safe. About 250,000 barrels of pork are therefore repacked every year. The quantity of pork received in New York in 1852 was 300,000 barrels, or 60,000,000 lb., and of hams and shoulders in barrels and tierces about the same quantity. The aggregate quantity of fresh and cured pork therefore received in New York city may be stated at 213,250,000 lb. The Cincinnati Price Current, a reliable authority, calculates the hogs of commerce slaughtered annually in the United States at 3,000,000, and at an average of 8 dollars these would be worth 24,000,000 dollars, nearly £5,000,000 sterling. This is exclusive of the consumption by the town and country populations. At Philadelphia 47,000 pigs are annually brought to market, the number having doubled itself in seven years. In New York City, in 1853, the swine slaughtered for local consumption numbered 133,196. The quantity of pork used fresh in the previous year, 1852, was stated at 37,000,000 lb.

Assuming the number of hogs killed annually in the United States, and packed for commerce there, as before stated, at 3,000,000, and the average yield of lard per hog being 32 lb., we have a total produce of 96,000,000 lb. of lard; of this amount 20,000,000 lb. are made in Cincinnati. England and Cuba take more American lard than all the rest of the world, each of these countries buying annually 9,000,000 or 10,000,000 lb. In the West Indies lard is very generally used as a substitute for butter, and the demand for lard over the world is greatly on the increase.

For the last four years the average exports of lard from Cincinnati have been as follows:—

Lard in barrels,	40,000 =	8,000,000 lb.
Lard in kegs,	110,000 =	4,400,000 „
Lard oil in barrels,	28,000 =	7,000,000 „
		19,400,000 lb.

Twenty millions of pounds of lard may be taken in one form or another as the export from Cincinnati, though full one-third of it is manufactured into lard oil chiefly for home consumption. The shipment of these products from the principal ports of the West, taking the whole as lard, is as follows:—

Cincinnati,	20,000,000 lb.
Louisville,	7,000,000 „
St Louis,	8,000,000 „
Pittsburg,	6,000,000 „
Chicago,	3,700,000 „
Other places,	11,170,000 „
	60,870,000 lb.

The Atlantic cities and small places in the interior will bring the aggregate up to 96,000,000 lb. (42,678 tons).

Two-thirds of all the lard produced in the United States, it will be seen, is shipped from the Ohio valley.

In averaging the weight of a hog at 200 lb., the produce is usually divided as follows:—

Hams, 15 lb. each,	30 lb.
Shoulders,	32 „
Leaf lard,	25 „
Rump,	8 „
Side meat,	70 „
Head and feet,	25 „
Wastage,	10 „
	200 lb.

Professor Wilson, in his recent special report on the New York Exhibition, states that the hogs are usually allowed to run in the woods, and to seek their food on acorns, beech-mast, grass, &c., until the end of August or the beginning of September, when those intended for slaughtering are turned into the corn (maize) fields, where they remain eating and fattening until the end of October, when they are collected and sent up to market. In cases where small lots only are kept, they are usually purchased by drovers or jobbers, who again dispose of them to the large dealers. In other cases, the farmer drives them to market himself, and deals directly with the consumer. Some of the more extensive farmers will have as many as from 1000 to 3000 hogs, but from 200 to 500 is the more common average. The age at which they are sent to market

varies from 12 to 18 months. The phrase "going the whole hog," must have originated in Ohio, for there the inhabitants are the most hoggish community of the entire American Union.

What crocodiles were in Egypt, what cows are in Bengal, or storks in Holland, pigs are in Cincinnati, with this trifling difference, their sacredness of character lasts but as long as their mortal coil; and this is abbreviated without ceremony, and from the most worldly motives. In life, the pig, if free, is honoured; he ranges the streets, he reposes in thoroughfares, he walks beneath your horse's legs, or your own; he is everywhere respected; but let the thread of his existence be severed, and, shade of Mahomet, what a change! They think in Cincinnati of nothing but making the most of him. How many of his kind perish annually to cement the vast prosperity of the city of hogs can scarcely be told.

About twenty years ago, Cincinnati contained only one-fifth of its existing population. A few bold speculators began the trade. Selecting the hams and sides of the animals, they made pickled pork; of the rest they took small account. Soon, however, the idea occurred to one more acute than his fellows, that the head and the feet—nay, even the spine and the vertebræ—might be turned to account; trotters and cheeks had their partisans, and these parts looked up in the market. About this time the makers of sausages caught the inspiration. They found these luxuries saleable, and so many pigs were to be slaughtered that the butchers were willing to do it for nothing; that is to say, for the perquisite of the entrails and offal alone.

The next step was due to the genius of France. A Frenchman established a brush manufactory, and created a market for the bristles, but his ingenuity was outdone by one of his countrymen, who soon after arrived. This man was determined, it seems, to share the spoil; and, thinking nothing else left, collected the fine hair or wool, washed, dried, and combed it, and stuffed mattresses with it. But he was mistaken in thinking nothing else left. As but little was done with the lard, they invented machines, and squeezed oil out of it; the refuse they threw away. Mistaken men again. This refuse was the substance of stearine candles, and made a fortune to the discoverer of the secret. Lastly came one who could press chemistry to the service of mammon; he saw the blood of countless swine flow through the gutters of the city; it was all that was left of them, but it went to his heart to see it thrown away: he pondered long, and then, collecting the stream into reservoirs, made prussiate of potash from it by the ton. The pig was thus used up, and nothing else was left to turn to profitable account. A large trade is carried on in sausage-skins; the entrails and bladders fetch a good price. The congealed grease, forming the lard of commerce, is in extensive use for culinary pur-

poses, for perfumery, ointments, salves, &c. The oil expressed from lard is chiefly used for burning, for lubricating machinery, and generally as a substitute for olive and other oils.

In the United States, fish is invariably fried in lard; and it has now also come into extensive use in England for this purpose.

Fine leaf-lard, if unmixed and well managed, is found to be a very profitable article of shipment. It is put up in neat white hooped kegs, containing from 60 to 80 lb. each. The lard is poured into the kegs at the head, and so soon as it has cooled and settled down, the surface is made level, and covered with white paper, which prevents it from adhering to the lid, when opened for inspection. It is also put up to a considerable extent in bladders of about ¼ cwt. each, and shipped in hogsheads packed with bran or cut straw. It is important that the bladders should be cleaned by scraping and the use of acids, so that they may be tolerably transparent. The inferior lard is put up in packages of any size, which, when large, require, however, to be iron-hooped. This inferior lard is chiefly used for chandlery purposes by the oil and soap makers, and for greasing machinery.

It is but a few years ago that the manufacture of lard-oil was considered scarcely of any importance; now it occupies a prominent position, and determines to a great extent the value of the hog.

In the Western States lard-oil has taken the place of all other oils, and its manufacture continues to increase. In quality it is beginning to outrival fish-oil, and is superior to the best sperm for lubricating the surface of machinery. Through the entire south-west and north of the Union, the amount employed for the purpose is immense; and as to the manufacture of the article out of Cincinnati, almost every place where it can be readily and cheaply obtained has its manufactory. The manufacture has this rare advantage, that a ready sale is always found for the stearine and for the oil wherever sent to. The average price of the best lard-oil at Cincinnati, in the summer months, is about 50 cents the gallon; in the winter months, 60 cents (2s. 6d.) Stearine preponderates in amount over oil in winter, hence the price rules higher then.

From experiments which were set on foot by the American government, some years ago, through the Franklin Institute, as to the relative difference between lard and fish-oil, it was found that one pound of lard burned as long, and gave as much light, as one pint of the best sperm-oil. The lard in Philadelphia cost 4d. a-pound, and the oil 8d. a-pint, which experiment proved a saving of 50 per cent in favour of the lard. In the Western States, where lard is much cheaper, the saving is of course greater.

Messrs Cornelius & Co., of Philadelphia, immediately manufactured lamps suited for burning lard-oil, and these soon came into general use.

Professor Olmstead, of Newhaven, discovered that, by the addition of 1 lb. of rosin to 3 lb. of lard, the mixture, when stirred, became semi-fluid at 72° Fahr., and melted at 90°, remaining transparent and limpid at that temperature. The discovery is of use to various parties;—to machinists, by neutralising the acidity of the lard, which corroded metals.

A thin coating of the compound lard upon a grate or sheet-iron stove keeps it free from rust; mixed with soot, it prevents it from growing rancid. It renders leather impervious to water, and does not prevent it receiving a polish; and it may be made into a paste by thickening, for lubricating wheels, &c.

There are in Cincinnati forty manufacturers, large and small, of lard oil. These consume on an average, each week the year round, 1000 packages of 300 lb. each, equal to 15,000,000 lb. per annum. From this is to be deducted for stearine one-third, leaving 10,480,000 lb., equal (allowing 8 lb. to the gallon) to 1,110,000 gallons. This may be considered as a fair average of the amount manufactured and consumed yearly in Cincinnati. To the latter account must be set its five or six large candle-factories, which consume the stearine in combination with tallow.

As manufacturers are unwilling to divulge the quantity of candles made, we are left to infer it from the large amount of stearine which enters into their composition—2 lb. being consumed for each lb. of candles. It is to be remembered that the stearine, after blending with, has to be extracted from, the tallow.

Dressing the bristles in Ohio for the Atlantic markets gives employment to about a hundred hands, and the hoofs are partly boiled down into glue.

In some establishments, after curing the large hams, the rest of the carcass of the hog is cut up, steamed in large vats under a pressure of 70 lb. to the square inch, and the whole, bones and all, is then reduced to a pulp, from which the fat is drawn off. The residue is either thrown away or turned into the soil as manure.

The slaughterers formerly got the gut-fat for the labour of killing and cutting up, carting the hogs more than a mile to the pork-houses free of expense to the owners. Every year, however, enhances the value of the perquisites, such as the fat, heart, liver, &c., for food; and the hoofs, hair, and other parts for manufacturing purposes. For the last two or three years as much as 1s. per hog has therefore been paid as a bonus for the privilege of killing.

The imports of lard into the United Kingdom within the last year or two have been exceedingly heavy, and, under the fluctuations of the tallow market, a high range of prices has been maintained. The exports, which in 1853 were but 3478 tons, last year reached 11,585 tons, being more than 1000 tons in excess of the large receipts in 1848. As the quantity required for domestic

purposes does not exceed 5000 tons per annum, the excess must find consumption in some way as a substitute for tallow, or for lubricating machinery.

The hair, hoofs, and other offal, and the cracklings or residuum left on expressing the lard, are employed in the manufacture of the prussiate of potash, of which 60,000 lb. are annually made. It is used extensively in the print-factories of New England for colouring purposes.

Hog-skins are imported for saddle-seats, covers of pocket-books, and other purposes. In China the hides have long been made into shoes.

Pigs' tongues are sometimes shipped from America in full-formed half-barrels of 100 lb. They are cured with saltpetre, to give them a fine red colour.

By way of summary, I give the following return of the imports into the chief port where the provision trade centres, showing last year an aggregate import of nearly 26,000 tons of commercial products of the hog, exclusive of those brought in alive from Ireland, coastwise, and by rail, &c.

COMPARATIVE IMPORTS OF PORK, BACON, HAMS, AND LARD, TO LIVERPOOL, IN THE YEARS ENDING 30TH SEPTEMBER.

Years.	Pork, bls.	Bacon, cwts.	Hams, cwts.	Lard, tons.
1847, . .	35,634	53,523	20,313	4,893
1848, . .	31,511	119,158	16,296	9,572
1849, . .	37,152	224,794	22,768	4,892
1850, . .	20,177	156,347	15,863	10,049
1851, . .	5,762	66,161	5,714	3,749
1852, . .	1,629	26,103	94	3,349
1853, . .	38,164	118,906	10,159	4,756
1854, . .	30,469	224,201	17,035	11,065

The total for 1853 and 1854 includes American, Continental, and Irish, while the figures for previous years only note American.

After this sketch of the important commercial products of this domestic animal, let no one hereafter venture to despise the hog. From the care with which the best races are preserved with us, and the greater attention paid to breeding and feeding, there is more proportionate food, and of a more delicate quality, obtained from the carcass in England; but we do not rear swine to such an extent as to carry on the manufacture of lard oil and the other commercial products on any considerable scale; still, our prime smoked bacon sides and dairy-fed porkers, our brawn and Bath chops, or cheeks ("choppers," as they are vulgarly called), and our country sausages (when the latter are not town-made), have a very high repute,—and even in the matter of pickled pork we stand superior to all competitors.

Still there is many a useful hint to be obtained by an investigation of the practice pursued in different countries, even as respects the breeding, treatment, and commerce of domestic animals.

LIEBIG'S SO-CALLED MINERAL THEORY: WHAT IS IT?—TESTED BY PRACTICE.

It was not till the commencement of the present century that agricultural chemistry began to take the place among the sciences which it now occupies. Chemistry general, indeed, had but just emerged from the mysteries of the alchemists, and the obscurities of the phlogistians. The student of vegetable physiology, too, was perplexed by the wild speculations with which he was beset, while geology was quite unknown as a science. It is not to be wondered at, then, that the theory of agriculture, based on these three sciences, was nothing more than the crude thoughts and fanciful speculations of every writer on the subject. Some insisted that the food of plants was nothing else but minutely-pulverised earth, and that thus, if the soil was brought to a minute state of division, there would be no use for manure—others maintained that salt and oil were the food of plants, and to assist the farmer in raising crops, recommended composts of oil and earth—others guessed at air and water as the fertile sources of vegetation; while then, as now, there were not a few ready to "speculate on the credulity of farmers" by inventing seed-steeping mixtures, which were warranted to produce fine crops without ploughing or manuring the land. Ludicrous as they may appear to us now, they were at the time defended by their several supporters with as much pertinacity as any theory of the present day by our learned savans.

Such was the state of matters when Davy commenced to deliver his lectures on agricultural chemistry. "At once the poet and the philosopher," he was gifted with an imagination which enabled him to originate and illustrate his theories, while his mind, thoroughly imbued with philosophical principles, generalised, reasoned, and deduced from the facts and principles with which his own researches and those of others furnished him. Preceded by Black, Lavoisier, and the other eminent men of that time, who had overturned the phlogiston theory, and substituted another, based on sounder scientific principles, he availed himself of their discoveries and researches, and contributed in no small degree to the establishment of their theory. It is impossible to peruse Davy's *Lectures on Agricultural Chemistry* without feeling surprised at the rapid progress chemistry had made about that time, and without being struck with the bold and original views propounded by him. He divided the vegetable constituents into organic and inorganic, derived from the air, water, and the soil. "But though neither of these," he says, "supplies the whole of the food of plants, yet they all operate in the process of vegetation. The soil is the laboratory in which the food is prepared—no manure can be taken up by the roots unless water is present—and water or its elements exist in

all the products of vegetation. The germination of seeds does not take place without the presence of air or oxygen gas, and in the sunshine vegetables decompose the carbonic acid of the atmosphere."

His views, however, as to the form in which the food of plants was absorbed and assimilated by them were not very distinct, owing to the imperfect state of the science at the time, and the want of proper experiments. As regards the organic constituents of plants, he held that all manures from organised substances contain the principles of vegetable matter, which during putrefaction are rendered either soluble in water or aeriform, and in these states they are capable of being assimilated to the vegetable organs. He maintained the necessity of putrefaction or fermentation in animal and vegetable matters before they could be used as food for plants, and so strongly as to recommend the application of dung in its fresh state to the land, so that "none of its volatile parts, which are the most valuable and the most efficient," might be lost. We think that he acquiesces in the humus theory, when, arguing from the experiments of Hassenfratz and Saussure, he alleges "that animal and vegetable matters deposited in soils are absorbed by plants, and become a part of their organised matter." In another part of his work he appears to have modified his opinion about fermentation. He states, that in introducing plants into strong fresh solutions of sugar, mucilage, &c., they all died; but that they lived in the same solutions after they had been fermented. He supposed that fermentation was necessary to prepare the food of plants, but that he "had since found that the deleterious effect of the recent solutions was owing to their being too concentrated, in consequence of which the vegetable organs were probably clogged with solid matter, and the transpiration of the leaves prevented." This opinion he formed after performing the experiments with solutions very much diluted. It may be observed here that there is considerable difference of opinion on this part of the subject at the present day, Liebig and many other chemists maintaining that sugar, gum, starch, &c., as such, are not food for plants. "The office of the leaves," says Liebig, "is to form sugar, &c.; consequently, if we convey these substances through the roots, the vital functions of the leaves must cease; and if the process of assimilation cannot take another form, the plant must die," while other chemists dissent from this view.

The views entertained by Davy with regard to the inorganic constituents of the food of plants may be said to be those of Liebig in embryo. His words are—

The chemistry of the more simple manures—the manures which act in very small quantities, such as gypsum, alkalies, and various saline substances—has hitherto been exceedingly obscure. It has been generally supposed that these manures act in the vegetable economy in the same manner as condiments or stimulants in the animal economy, and that they render the common food more nutritive. It seems, however, a much more probable idea that they are actually a part of the true food of plants,

and that they supply that kind of matter to the vegetable fibre which is analogous to the bony matter in animal structures.

Four earths generally abound in soils—the aluminous, the silicious, the calcareous, and the magnesian. Plants have been made to grow in given quantities of earth. They consume very small portions only, and what is lost may be accounted for by the quantities found in their ashes—that is to say, it has not been converted into any new products. In all cases the ashes contain some of the earths of the soil in which they grow.

This, then, is a summary of Davy's views on the theory of agriculture; and if we consider the originality of these views, the novelty of the experiments with which they are supported, and the great importance of their results to practice, we are certain that never was title better deserved than that which has been universally bestowed on him—viz., the "Father of agricultural chemistry."

Davy was followed in the path he had opened up by numerous able investigators in different countries: in France we had Boussingault; in Germany, Sprengel; in Holland, Mulder; in Britain, Johnston. But though we do not undervalue the labours of these chemists, we intend at present to confine our remarks more particularly to the opinions of Liebig, whose name has become as much associated with agricultural chemistry as that of any other living chemist. However much Liebig may have been known in the scientific world before 1840, it was not till then that his name was brought prominently before the agriculturists of this country by the publication of his work, *Organic Chemistry applied to Agriculture and Physiology*. The boldness of his opinions, the freshness of his ideas, the novelty of his theories, supported as they were by facts, laid before the public in this work in a clear, forcible style, enlisted at once the non-scientific portion of his readers in this country in his favour. Previously many rising young chemists from this and other countries, attracted by the fame of Liebig, had proceeded to Giessen to study under him, so that that town, already famous for its university, received additional lustre from the talent which was collected in it, from the important researches carried on in it, and from the brilliant discoveries in science which from time to time emanated from it, at the same time giving a name of distinction, known throughout Europe, to those opinions advocated by the master and pupils at the university.

Never did the farmers of East Lothian do themselves greater honour than when they invited this famous chemist, when in this country, to a public entertainment. It was a just homage paid by practice to science—an acknowledgment by practical men of the services of men of science. It is to be regretted that the confidence reposed in Liebig by the farmers of Britain should ever have been shaken. But his devoted adherence to a theory nominally correct—his discovery of a compound salt—which led to the patenting of a manure under his name, and which proved very unsuccessful as

such, caused farmers to place less reliance on the suggestions of chemists than they used to do.

Liebig has the merit of being the first who laid distinctly before the public sound views as to the sources of the constituents of plants. From what we have said above, it will be seen that there were not wanting labourers in this field of science; but still the whole question was too much enveloped in surmises and doubts to be of any practical benefit to the agriculturist; and it was not till Liebig devoted his attention to the investigation that it became reduced to settled principles.

All chemists are agreed as to the sources from which the oxygen and hydrogen of plants are derived, the principal of which is water. All likewise are of opinion that their carbon is got from the air principally, and partially from the soil. But here Liebig and his school differ from other chemists of eminence. The opinions held by men of science previous to the published works of Liebig in 1840, as to the source of the supply of carbon to plants from the soil, may be learned from this extract from Liebig:—

> The opinion that the substance called *humus* is extracted from the soil by the roots of plants, and that the carbon entering into its composition serves in some form or other to nourish their tissues, is so general, and so firmly established, that hitherto any new argument in its favour has been considered unnecessary; the obvious difference in the growth of plants, according to the known abundance or scarcity of humus in the soil, seemed to afford incontestible proof of its correctness.
>
> Yet this position, when submitted to a strict examination, is found to be untenable; and it becomes evident, from most conclusive proofs, that humus, in the form in which it exists in the soil, does not yield the smallest nourishment to plants.

Humus, he tells us farther, is woody fibre in a state of decay, which has the property of converting surrounding oxygen into carbonic acid. It is humus which gives the dark colour to soils, and produces what is called mould. It is easily soluble in alkalies, but only slightly soluble in water, and hence Liebig argues it cannot be so extensively used as food for plants as vegetable physiologists asserted. It is beyond our purpose to enter now minutely into this subject, by following Liebig and others into the distinctions they have made of the different forms in which humus and its products are met with in the soil; suffice it to say, that these distinctions are made principally according to the solubility or insolubility of the substances. Liebig has also shown, that though the humus may be made available as food for plants by being rendered soluble by alkalies, still the quantity that would be taken up in this state would be far from sufficient to supply the necessary amount of carbon to plants. It must be admitted, however, that those who oppose Liebig's views of this question, argue that the principal supply of the carbon of vegetables is from the atmosphere, and that the humates or compounds of humic acid, and the alkalies and earths, only give a very small portion of carbon to plants.

The difference between the opinions of the two parties, then, is this: According to Liebig, the whole of the carbon of plants is derived from carbonic acid, yielded both by the air and the soil, in which humus is always in a state of change, absorbing oxygen and producing carbonic acid. The other party, again, allege that the humus is taken up directly by the plants, by means of alkalies and earths, and its carbon assimilated by the plants. We do not think that this question is of such vital importance to the practical agriculturist; both parties admit the necessity of having carbon present in the soil, and of making it as soluble as possible, that it may be taken up by the plant. We leave it, therefore, to the chemists to solve the question as to whether vegetables take up humus directly and assimilate its carbon, or whether its carbon is first converted into carbonic acid in the soil, which is then absorbed by the plant.

The nitrogen of plants is obtained, according to some chemists, wholly from ammonia, which is washed down from the atmosphere by rains, or is formed in the soil by the decomposition of animal and vegetable matters. Other chemists allege that nitric acid, as well as ammonia, yields that important element to plants. We do not think that this is a matter of much importance to the practical agriculturist. Both parties agree that nitrogen must be present in the soil in some form or other, and that in whatever form it is taken up, its compound should be as soluble as possible. And we think that it will be no easy matter even for chemists to tell what part of the nitrogen has been derived from ammonia, and what from nitric acid, these two compounds are so easily resolvable the one into the other. Liebig, formerly of the first opinion, now says that "there is every reason to believe, that in the nutrition of plants nitric acid can replace ammonia as a source of nitrogen."

In our remarks on Liebig's opinions regarding the inorganic constituents of plants, we think it better to make considerable extracts from his work lately published * in this country:—

On the most diversified soils, in the most varied climates, whether cultivated in plains or on high mountains, plants invariably contain a certain number of mineral substances, and, in fact, always the same substances; the nature and quality, or the varying proportions of which, are ascertained by finding the composition of the ashes of the plants. The mineral substances found in the ashes were originally ingredients of the soil; all fertile soils contain a certain amount of them; they are never wanting in any soil in which plants thrive.

All plants, without exception, require for nutrition phosphoric acid, sulphuric acid, the alkalies, lime, magnesia, and iron. Some important genera require silica. Those which grow on the sea-shore and in the sea require common salt, soda, and iodides of metals. In some genera the alkalies may be in part replaced by lime and magnesia, or these latter by the alkalies. All these substances are included in the term mineral food of plants. Carbonic acid and ammonia are the atmospheric food of

* *Principles of Agricultural Chemistry, with special reference to the late Researches made in England.* By Justus Von Liebig. London: Walton & Maberly.

vegetables. Water serves both as a nutritive substance, and, as a solvent, is indispensable to the whole process of nutrition.

Liebig then states that a soil which has produced a crop of any kind of vegetables is exhausted of some of its mineral constituents, equal in amount to what is found in the ashes of the crop produced, that the fertility of the soil is diminished to that amount, and that hence *one of the conditions of fertility in a soil is the presence in it of certain mineral constituents.* This lost or diminished fertility is restored by means of solid and liquid manure, or the *excreta* of men and of animals, which contain both the mineral and the atmospheric food of plants, the latter being a clear addition to what the atmosphere supplies.

The solid and liquid parts of the food of plants contained in the soil enter the organism of the plant through the roots ; their introduction is effected by means of water, which gives to them solubility and mobility. Many dissolve in pure water, others only in water which contains carbonic acid, or some salt of ammonia.

Animal manure not only supplies the plants with a certain amount of their mineral and atmospheric food, but also provides them in carbonic acid and ammoniacal salts, those substances which are the most indispensable for the introduction into the vegetable organism of the mineral constituents, which by themselves are insoluble in water, and this to a larger amount in the same time than could be effected without the co-operation of the decaying organic matter.

The fertility of a soil is proportional, not merely to the quantity of mineral constituents present in it, but to the quantity of mineral constituents soluble or available as food for plants present. "To improve, enrich, or fertilise a soil, therefore, by proper means, but without adding to it any mineral constituents, is to render soluble, or available for the plant, a part of the insoluble constituents of the soil." Now, this is done in various ways—by giving free access to the air and water to the soil, by the proper comminution of the land, which of course presupposes drainage, and by this means also allows the admission of the atmospheric constituents, carbonic acid and ammonia. But it follows, as a natural consequence, that if none of the mineral constituents of the soil which are carried off by the plants be restored, and what is stored up in an insoluble state be rendered soluble by the mechanical preparation of the soil and the atmospheric constituents, the soil must ultimately become exhausted or infertible. Hence also the effect of raising crops from a soil by salts of ammonia alone is to exhaust the soil.

The efficacy of all the mineral constituents of the soil taken together, in a given time, depends on the co-operation of the atmospheric constituents in the same time, and *vice versâ.*

The supply of more carbonic acid and ammonia, by means of ammoniacal salts and humus, than the air can furnish, increases the efficacy of the mineral constituents present in the soil in a given time. In a soil rich in the mineral food of plants, the produce cannot be increased by adding more of the same substances. In a soil rich in the atmospheric food of plants, rendered so by manuring, the produce cannot be increased by adding more of the same substances.

From land rich in the mineral constituents we may obtain in one year, or for a series of years, by the addition of ammonia alone in its salts, or of humus and am-

monia, rich crops, without in any way restoring the mineral substances removed in these crops. The continued use of these manures produces, sooner or later, an exhaustion of the soil.

If, after a time, the soil is to recover its original fertility, the mineral substances extracted from it in a series of years must be again restored to it.

These remarks and extracts will be sufficient to give some idea of Liebig's theory. In his last work, from which we have taken these extracts, he insists as strongly as ever on the importance and necessity of the mineral constituents of the soil to vegetable growth; nor does he modify his previously published opinions in any respect, excepting in admitting nitric acid as a source of nitrogen as well as ammonia, and the part which animal and vegetable substances in a state of decay play in supplying carbonic acid and ammonia as solvents of the mineral constituents. His last work has been published in reply to the many misrepresentations which have been made of his opinions, and particularly in answer to the attacks made upon him by Mr Lawes in the *Journal of the Royal Agricultural Society of England.* He shows that Mr Lawes entirely misunderstood his theory, and that, from what he states, he appears never to have read Liebig's works; that, from the method which Mr Lawes adopted of performing his experiments, they were no tests whatever of Liebig's theory; and that their "results prove exactly the reverse of that which, in his opinion, they ought to demonstrate;" nay, Liebig regards them as the most "incontestible proofs in favour of that very doctrine which they were originally intended to disprove!"

We do not intend to enlarge on the discussion between Liebig and Lawes, but refer our readers to the books containing their several opinions, and particularly to the last of Liebig, in which he has thrown the principles of agricultural chemistry into fifty propositions, upon which he grounds his theory, and by which he completely overturns Mr Lawes' arguments. Men of science are very liable to have their opinions misrepresented. Boussingault found, after he had published his table of the manurial value of different substances, according to the amount of nitrogen contained in them, that he was so much misunderstood that he soon issued another table, giving, besides the amount of nitrogen in different substances, the quantity of phosphoric acid contained in them.

But Liebig has been still more misrepresented. There are, no doubt, expressions in his works which, being isolated, might tend to cause this misrepresentation; but it is unfair in any one to make use of the words of an author in this way. For instance, we heard it asserted again and again that Liebig's theory was, that plants did not derive any of their carbon from the soil. And this misconception has arisen very much from some expressions which have fallen from him, such as—"a certain quantity of carbon is taken every year from the forest or meadow, in the form of wood or hay, and in spite of this the quantity of carbon in the soil aug-

ments;" and again, "it may be affirmed with positive certainty, that manure neither serves for the production of carbon, nor has any influence upon it." Professor Johnston, in alluding to the tendency of some of Liebig's hasty expressions to mislead, very properly observes: "By taking a one-sided view of nature, we may arrive at startling conclusions—correct, if taken as partial truths, yet false if advanced as general propositions, and fitted to lead into error such as have not the requisite knowledge to enable them to judge for themselves; or such as, doubtful of their own judgment, are willing to yield assent to the authority of a name." He then adduces a statement of Liebig's, that "when a plant is quite matured, and when the organs by which it obtains its food from the atmosphere are formed, the carbonic acid of the soil is no further required, and that during the heat of summer it derives its carbon *exclusively* from the atmosphere." He shows that Liebig could never have intended that statement to have its plain and literal meaning; for in the very next page he writes, that "the power which roots possess of taking up nourishment does not cease so long as nutriment is present."

His views regarding the supply of nitrogen to plants have been still more misunderstood. The principal offenders here are no doubt Messrs Pusey and Lawes, in as far as the attacks they have made on Liebig's so-called "mineral theory" have done more to disseminate incorrect views of the Professor's opinions than any other writers on the subject; for we find that, even on the Continent, agricultural writers have been misled by Mr Lawes' papers, and, adopting his language and reasoning, have condemned the so-called "mineral theory" of Liebig, who informs us himself that "Liebig's mineral theory is a pure fancy of Mr Lawes'." We are not, therefore, surprised that the learned Professor should have entered an indignant protest against the statements of Mr Lawes and others, adding that "it is not difficult to refute the opinions of another, if we ascribe to him assertions which he has never made." He appeals to his book, and allows it to speak; and he considers "it fortunate that Mr Lawes has not consulted nor read it, because we should otherwise have been deprived of a whole series of instructive experiments."

After an unbiassed perusal of Liebig's works, we can come to no other conclusion than that Mr Lawes had entirely mistaken his meaning. We do not deny but that certain hasty expressions of Liebig's, taken by themselves, and associated with his patent mineral manure (of which he has said himself "the idea was brought forth prematurely, and, as in the case of a child born before the time, death quickly followed"), might tend to mislead any one. But it is difficult to excuse the writer who endeavours to refute the opinions of another, and does not take pains first to ascertain what these opinions are. And certain we are that no unprejudiced reader, after an attentive perusal of Liebig's works,

ever could have supposed that he held the strong opinions attributed to him by Mr Lawes and others; to the effect, if we understand them aright, that while assigning too much importance to the mineral, he all but ignored the nitrogenous constituents of manures. We remember of reading the first edition of his work, in 1840, in which we were more struck with the value he attached to ammonia, as a source of nitrogen, and the part it acted in the soil in rendering the mineral constituents available for plants, than any other part of his work. There he says—"Animal manure acts only by the formation of ammonia." "Ammoniacal salts are formed in large quantities in putrid urine, which is employed in Flanders as a manure with the best results." "In a scientific point of view, it should be the care of the agriculturist so to employ all the substances containing a large proportion of nitrogen which his farm affords in the form of animal excrements, that they shall serve as nutriment to his own plants. Cultivated plants receive the same quantity of nitrogen from the atmosphere as wild plants, but this is not sufficient for the purposes of agriculture." Liebig also, in the same work, first brought prominently before British farmers, in a quotation from Boussingault, the value of guano, principally from the ammonia it contained, and held up the Chinese as an example for their use of nitrogenous manures.

We are, moreover, inclined to think that mistakes are sometimes committed by practical men in reading scientific works. For instance, what a scientific man may mean by *exhaustion* of the soil, may not be the same as the meaning which a practical man attaches to it. Liebig holds that a plant will grow in a soil if all its mineral constituents be present, though the atmospheric constituents may be awanting, or present only in very small quantity; but that, if any one of the mineral constituents be absent, or abstracted entirely by the same species of plant growing, the land will be in an exhausted state, and cannot produce that plant again till that constituent be added to it in a form available as food for the plant. But a practical man means more by the term *exhaustion*. A practical man considers that soil exhausted which has been overcropped, and will not produce an average crop for soil of that description. It matters not to him whether this exhaustion has arisen from a deficiency of the mineral or the atmospheric constituents. In the former case, the man of science means the *normal* growth of plants, and, knowing that soils are actually enriched with carbon and nitrogen by plants growing upon them for a series of years, and not removed while the mineral constituents are not in the least increased, he concludes that these two elements may be supplied to the plants otherwise than by the soil, which, therefore, he says, is exhausted only of that which can be got from the soil alone. The agriculturist, on the other hand, means the *abnormal* growth of plants, which requires both the mineral and atmospheric constituents in the soil to produce a crop.

It appears to us that it is very much owing to proper attention not being paid to these distinctions that there are often such apparent differences in the statements of scientific and practical men. And it is evident that we must look here for the cause of the misconception of Liebig's meaning. Even supposing him to have held the opinions attributed to him by Mr Lawes and others, the experiments by which that gentleman attempted to refute them utterly failed in attaining their object. For it should first have been clearly ascertained whether the soil on which they were performed were deficient in the mineral constituents. This Mr Lawes did not do; and the experiments themselves have clearly proved that, so far from the soil being deficient in these elements, it was more than ordinarily rich in them; and, therefore, it was not to be expected that the application of any of these substances could have had an appreciable effect. We have here an instance of the clashing of the opinions between a scientific and a practical man. According to Liebig's opinion, the soil was not exhausted; according to Lawes, it was. Any one, on reading Liebig's work, published in 1840, could not for one moment suppose that he doubted the efficacy of nitrogenous manures added to the soil. And it is very unlikely that the precise experiments of Kuhlman with that class of manures, published in 1843, could have escaped him; so that, if he ever held other opinions, his attention being drawn to the subject, he might have revised them. The agricultural public is certainly deeply indebted to Mr Lawes for the disinterested part he has acted in bringing these experiments before them, for the care he has bestowed upon them, and the accuracy and great trouble he has shown in their performance; but still we must estimate them at their true value. We do not consider them in any way an unfavourable test of Liebig's theory; they seem to have been devised and undertaken without due attention to scientific principles, and not according to the rules of scientific research: this will be apparent in a moment from the selection of the substances as manures with which he expected to overturn a theory. They will always hold a prominent place among the mass of agricultural facts that must be collected before proper scientific principles can be established in agriculture; but we do not think that the results obtained from them are of so positive and general a nature as to warrant our pronouncing their applicability to the farm of even "Mr Lawes' neighbour, much less to the country in general."

The true test of any agricultural theory is its applicability to practice. Now, let us try Liebig's so-called mineral theory by this test. About 150 years ago, Jethro Tull published his theory and system of agriculture. The successful results he obtained from growing wheat year after year on the same soil, by simply pulverising it, and giving no manure, led him to form the opinion that the food of plants was minutely divided particles of soil, and

that manure was of no use whatever, excepting to aid in producing this minute division of the soil. By thorough working of the soil by means of the horse-hoe, particularly in summer, he was enabled to produce finer crops of wheat than his neighbours did according to their system, with a supply of manure. Practice was at this period in advance of science, and from want of being guided by proper scientific principles, which were then unknown, Tull fell into errors, and his system, correct in the main, was not generally adopted. Science was at fault, not practice. About five or six years ago, when the agricultural interest was passing through that state of transition, brought on by a change in fiscal regulations—when a host of Job's comforters appeared on the stage, offering to relieve the distressed farmers from their difficulties, by methods which were each regarded as a panacea for all agricultural ills by its advocate—some recommending an inordinate application of manure, others no manure at all—some irrigation, others guano—some the feeding of stock, others the growth of particular vegetables—some an improvement in our steadings, others an improvement in our fields; and when pamphlets on agricultural subjects were showered down so thick as nearly to crush the devoted farmer, a small unpretending one, entitled *A Word in Season*, appeared among the rest.

The author of this pamphlet, adopting Tull's principles, but differing from him in the method of carrying them out, and guided by the light of modern science, has been more fortunate than Tull in evoking inquiry into the subject. The amiable incumbent of Loys Weedon has shown results from his plan of growing wheat that may well startle the purely practical agriculturist, but which have been productive of much useful inquiry to the intelligent and scientific farmer. The man of science, arguing from the theory lately promulgated by Liebig and others, considers it possible to accomplish what Mr Smith has done. The soil is the great storehouse of the mineral constituents of plants, theory tells us, either in a soluble or insoluble state. The constant pulverising and exposure to the air of the soil brings these constituents into a proper state as food for plants, and allows it to absorb, at the same time, the ammonia of the air in sufficient abundance for the growth of the plant. Liebig says, then, let plants be supplied with a sufficiency of their mineral constituents; let ammonia be added to the soil, not only sufficient to supply the plant with nitrogen, but also to dissolve the mineral constituents: the atmosphere contains this ammonia in sufficient abundance, if the capacity of the soil to absorb it can only be increased. The great means of increasing this capacity of the soil is pulverisation, by practising which Mr Smith has apparently, at least, verified the speculations of Liebig. We say *apparently*, for there might be doubters who would consider Mr Smith's soil richer in ammonia than most soils. We think this very unlikely from its nature;—"the staple, when the field

was first dug, was but 5 inches deep; the subsoil of four-fifths of the land being yellow clay, the rest a mixture of sand, gravel, and clay." Supposing, then, that all the ammonia has been obtained from the atmosphere, what must ultimately be the effect of this constant cultivation of the same crop on the same field, without the addition of manure? In the common language of farmers, the soil will become exhausted—of what? of ammonia? The ammonia is not derived originally from it, but through it, and its supply in the atmosphere is inexhaustible; but the soil will become exhausted, through time, of its mineral constituents.

Such, then, is the reasoning of the advocates of the so-called mineral theory. They insist upon a full supply of ammonia or nitrogen in another form to the plant; they consider that a sufficient supply is to be found in the atmosphere, if it could be made available for plants by means mechanical or otherwise: if it cannot, then it must be supplied in manures. The Loys Weedon system, then, differs from that by which equal crops are raised by means of nitrogenous manures, mainly in the plan adopted for supplying the nitrogen. In the one case, the principal expense is in the labour bestowed in bringing the soil to that state in which it will absorb the largest amount of ammonia from the atmosphere; in the other case, the expense is in the purchase of the nitrogenous manure. Are we prepared, then, to recommend it for general adoption? Certainly not. We consider it the most exhausting system that can be adopted, with the exception of those cases where nitrogenous manures alone are used. Besides, we do not think that, in the present state of the labour market, the Loys Weedon system would be practicable throughout the country, for it must not be forgot that pulverisation by the plough and other implements is never so effectual as by the spade and fork used by Mr Smith, which entails an immense expense for manual labour.

We need scarcely mention that, if the successful results of the Loys Weedon system can be explained by Liebig's theory, the ordinary operation of fallowing and green-cropping land and their effects, which are very similar to the Loys Weedon system, are a further confirmation of the so-called mineral theory. But while we do not recommend this system as a whole for general adoption, there is a part of it to which we should make as near an approach as possible: we mean the thorough pulverising of the soil. Our attention has been particularly directed to this subject by the publication of a small book * by Mr Stephens, author of *The Book of the Farm*. Requested by the Marquess of Tweeddale to lay before the public the operations which have been carried on at Yester under his lordship's superintendence, Mr Stephens has done so with his usual clearness. The great difference between the

* *Yester Deep Land-Culture.* By HENRY STEPHENS. William Blackwood and Sons, Edinburgh and London.

ordinary and the Yester system of cultivation may be learned from the following quotation:—

The only object in using the plough, and some other large implements, is the pulverisation of the surface-soil and part of the subsoil. The ordinary and the Yester treatment of either soil both aim to attain that object, but the difference in the two methods consists in this, that the ordinary practice attains only an imperfect and temporary pulverisation of a little more than the surface-soil, 7 or 8 inches deep—for subsoiling is very seldom practised; while the Yester plan attains an effectual and durable pulverisation of both soil and subsoil to the depth of 22 inches.

Again—

The characteristic distinction of the Yester system of farming is the very permanent and substantial nature of the treatment which the land receives. It does not, like that pursued with the common plough, glaze the surface, and increase the adhesiveness of the furrow-slice in strong land in a moist state; it is not the mere scarification which the grubber gives to the surface-soil; it is not the tearing into shallow stripes which the ordinary subsoil-ploughs effect in the subsoil; but it is the laying over of the surface-soil in a deep, broad, and broken furrow-slice in immediate precedence of the upraising of the subsoil from a great depth, as far as and no farther than to mix it completely with any desired proportion of the surface-soil.

We consider the Yester system of pulverisation a near approach to that practised at Loys Weedon; and the results—with the aid of manure, however—have been quite as successful. Indeed, the balance-sheet appears favourable enough to induce even tenants, with subsoils similar to those at Yester at least, to attempt these operations. We will allow those of our readers who are interested in this subject to judge for themselves after a perusal of Mr Stephens' work, simply stating that we agree with him in thinking that the consecutive operations performed at Yester must be considered the foundation of a new mode of farming. And while we do not mean in the least to detract from that fame to which the late Smith of Deanston was so justly entitled, as the father of thorough-draining and the advocate of subsoil-ploughing, we consider that great merit is due to the Marquess of Tweeddale for "foreseeing the good effects of deep pulverisation;" for the originality, skill, and patience he has shown in the invention and perfection of his implements; and for the steady perseverance with which he has carried out his designs in improving his land.

Mr Stephens' book is most seasonable at the present time, when, by the extensive use of light manures and of the grubber, the proper working of the land has been far too much overlooked. The grubber is a most valuable implement, and can scarcely be wanted as an auxiliary to the plough in the present extensive growth of green crops; but let us not consider it as a substitute for the plough. It is consistent with our experience that certain weeds cannot be got rid of by means of the grubber alone; and however commendable autumn cleaning by means of the grubber may be, we question much whether it will be practicable ever to carry it out extensively in ordinary seasons. There is another point not often alluded to by writers on autumn cleaning by means of the grubber: not only are the quickens and similar weeds brought to

the surface, but the stubble is also torn up and mixed with them, thus causing an additional expense in carting it off. It is absurd to suppose, as some writers have stated, that if bad weather should prevent the getting off of the weeds before spring, the winter's frost will kill them. We know a case where the severity of even last winter's frost had no effect on the vitality of quickens thus exposed.

But the principal fault we have to find with grubbing, as compared with ploughing, is its inability to give that thorough stirring to the land so necessary for increasing its capacity to absorb the atmospheric constituents of plants; and this is the point which bears principally upon our subject at the present time. The effect of the deep land-culture at Yester is to increase the soluble mineral constituents of the soil; and the subsoil there appears, from an analysis of Dr Anderson, to be a most valuable magazine of these, for it is richer in potash and alumina, and peroxide of iron, than the soil: so that, though no doubt much benefit is derived from the deep culture by allowing the air to permeate the 22 inches of well-pulverised soil and subsoil, leaving some of both its carbonic acid and its ammonia, and, by increasing the pabulum of the plants, thus allowing their roots to spread in every direction, yet we have good reason to suppose that some of the wonderful effects produced at Yester can be traced to the addition made to the soil from the subsoil of some valuable mineral constituents. One great difference between the Yester and the Loys Weedon systems is, that in the former manure is applied, though no doubt in much smaller quantities than is generally employed in the principal farms in East Lothian. We have here then, again, a perfect agreement between the so-called mineral theory and practice.

The rotation of crops can also be explained by this theory, and we will do so in Liebig's own words:—

When a given piece of land contains a certain amount of all the mineral constituents in equal quantity and in an available form, it becomes barren for any one kind of plant, when, by a series of crops, one only of these constituents has been so far removed that the remaining quantity is no longer sufficient for a crop.

A second kind of plant, which does not require this constituent, may yield on the same soil, after the former has ceased to thrive, one or a series of crops, because the other mineral substances necessary for it are present in quantities sufficient for its perfect development. A third sort of plant may thrive on the same soil after the second, if the remaining mineral constituents suffice for a crop of it. And if, during the cultivation of these crops, a new quantity of the substance wanting for the first has been rendered available by weathering, then, if the other necessary conditions be fulfilled, the first crop may again be grown on the same land.

On the unequal quantity and quality of the mineral constituents, and on the unequal proportions in which they are required for the development of the different cultivated crops, depends the *rotation of crops*, and the varieties of rotation employed in different localities.

There are other practices in the ordinary management of a farm, the nature and effects of which can be equally well explained according to the so-called mineral theory. Of these we may mention the practice of green manuring, including pasturing, and the quantities and kinds of different manures found suitable for appli-

cation to different soils and in different climates. Our space, however, will not allow us to enlarge on these at present.

We cannot conclude without expressing our gratification at the able manner in which Liebig has defended his opinions from the strictures of Messrs Lawes and Pusey. It was no slight accusation to insinuate against Liebig and the other celebrated chemists of the present day, that they taught doubtful chemistry. We will not defend the mineral manure, and the unfortunate association of Liebig's name with it. We have already said that this unlucky circumstance tended in no small measure to the misrepresentation of his opinions. Nor will we subscribe to the dictum of any man of science, however celebrated, the range of whose observations has been limited to laboratory and hot-house experiments, without ever being extended to the great laboratory of nature—the fields. Much less are we inclined to follow any practical man, however famous he may be, who draws hasty conclusions, and attempts to found a theory from a few experiments performed on some square yards of land in one district of England. The wise man's saying, "A little knowledge is a dangerous thing," is too often verified when the merely practical man begins to speculate from his own experience and that of his neighbours. And agricultural facts are too often mistaken for scientific principles, when an application of a man's experience is attempted in a locality different from that in which he acquired his experience.

It cannot be denied that agriculture is much indebted to science for its unprecedented progress during the last fifteen years. The rapid advances that all the sciences connected with agriculture have made in that time, is a proof that they have given forth no doubtful sound. The elaborate investigations that have been made of late into the composition and nutrition of plants, the numerous analyses of manures that have been published, the interesting papers that have appeared as to the mode of their action, and the benefits derived to agriculture by men of science pointing out their valuable constituents, were sufficient of themselves to lay the foundation of the science of agriculture. And if we are asked for more direct applications of science to practice, we would reply by directing attention to the importance attached by men of science to ammonia in manures, and particularly in guano; to their showing the double action of bones by their organic and their inorganic constituents; to the dissolving of bones in sulphuric acid, and to their fermentation—a suggestion of Liebig's carried into execution by Pusey; and to the use of coprolites and many other substances not employed before as manures. Certainly every practical man who has tried these different substances must admit that the results have been such as to convince him that they have not been the suggestions of doubtful chemistry. Such a law as that based on the experiments at Rothamstead, without reference to differences of soil, climate, and other circumstances—viz., that "ammonia is

especially suited to grain crops, phosphorus for turnips, and that the woody matters of straw are probably advantageous for turnips"—is more calculated to mislead than almost any suggestion made by the true man of science to the farmers, and by its empiricism has tended in no small measure to retard the progress of scientific agriculture among farmers. It is not by the enunciation of any such crude and limited observations, however generally stated they may be, that we ever expect to see, what we most fondly hope to see, the union of Practice with Science.

DESCRIPTION OF A FARM-STEADING UNDER ONE ROOF.

By James D. Ferguson, Land Agent, Bywell, Newcastle-upon-Tyne.

There can scarcely be a difference of opinion in respect to the advantage of suitable and well-planned farm-steadings greatly assisting the enterprise and skill of farmers in the proper and economical management of their stock, from which a great part of their profit arises. In the erection, however, farm-buildings in every country are invariably found to be expensive, even although the tenants agree to do the cartages, the necessary outlay being often far beyond what many landed proprietors can afford; and hence the many instances which we see over the country of small, inconvenient, and often indifferently planned steadings being erected, very unsuitable for the size and acreage of the farm. To obviate these serious objections, which, to many practical farmers, are well known and felt, I have designed a plan for a farm-steading, which—being nearly all under one roof, and supported on cast-metal pillars, is in some respects similar to a railway station, with abundance of light and air—will, it is believed, afford room for the stock kept on a farm of tillage land of upwards of 500 acres in extent, while the expense of the erection will be considerably less than when built (affording the same accommodation) of stone and lime in the usual manner.

It will be observed, from the plan hereby given, that a stone and lime wall 2 feet thick, encloses or surrounds the steading, and the whole roofed in and covered with slates. The roof is represented as being supported by twenty-seven cast-metal pillars, 20 feet apart each way, and of the same height as the outside wall, being 12 feet high, and the whole connected by scantlings of sufficient strength. The water falling on the roof is conveyed in valley gutters from each end to the middle of the building, as represented on the plan of a bird's-eye view of the roof; then down thirteen of the pillars into troughs for watering the cattle; or if water can be obtained in another way for that purpose, then that from the roof may be conveyed away in suitable drains.

The steading is lighted by twenty-five sky-lights or windows on the ridge or apex of the roof, each 6 feet long by 2 feet wide

on each side of the ridge, and ventilated by twenty-five ventilators, similar to the one invented and exhibited by me at the last Highland Society's cattle show at Berwick, and which was commended by the judges. The valves of the ventilators can be opened and shut at pleasure, by the simple operation of pulling a cord; while, at the same time, the fresh air is admitted below, through iron gratings fixed above air-channels, represented on the plan. The barn and granaries, with houses under them, are shown, two storeys in height, with stone and lime walls, for obvious reasons,—as also the engine, boiler, and coal-houses. The dung-yard, which is also represented under a light roof, with a railroad leading to it—hospital for horses—carpenter and blacksmith's shop—are shown on the outside of the building altogether.

A little from the end of the dung-yard is shown a circular tank, into which all the drainage of the steading is conveyed in socketed pipes; and it is conveniently placed in order that a pump may be worked in it by a power from the engine, to throw the urine over the dung, or for irrigation if necessary. The plan represents a passage, round the inside of the building, 4 feet wide; and railways, with turn-tables leading from the store and boiling-houses, will render the feeding and management of the cattle exceedingly convenient, as well as greatly facilitate the daily taking away of the dung from the stables and feeding-byres, which may be conveyed on a large light waggon which a man can push before him. It is conceived that inner divisions of stones and lime are perfectly unnecessary for partitions, as strong railing of home wood will suffice for the length of a long lease. To make these secure, cast-metal sockets, 7 inches square, and 8 inches in height, should be firmly bolted to heavy stones set in the floor at proper distances, as represented on the plan; and into these sockets upright wooden posts, 8 feet in height above the surface, should be inserted and fixed in the sockets, with bolts put through them horizontally. At the top, these posts should be connected together by strong cross-mortised pieces of wood, as well as securely fixed to projections cast on the sides of the metal pillars at the proper height. On almost every gentleman's estate there is often a great deal of wood (strong peeled larch poles, for example) for which a good market cannot always be got. It is believed that such wood might be economically used for these partitions, which, if securely put up, and made strong, would, though coarse (for a plane need not touch them), be perfectly good for the confinement of cattle, and would last a long lease; and at any rate (the bottom of the posts being kept dry), at a very trifling expense the divisions could be renewed, if need be, from time to time, at the expense of the tenant. It would be presumption in me to insist that the divisions or apartments represented on the plan are in every respect so conveniently arranged as perhaps they might be, or in every case of the proper size. Credit only is taken for the design,

which is entirely my own, and which I believe is original, having, with some slight alterations, been designed by me in 1846. Any of the divisions may be altered at a very trifling expense by the tenant. For example, two or three of the cattle-boxes may be made into one, or *vice versâ*, and the various places differently arranged from what they are represented, by merely shifting the sockets, and making the apartments larger or smaller, as the wish of the tenants may incline, to suit the various sizes or ages of the cattle. In the outside wall three large doors are represented, and four smaller ones, all of which should be made of close boarding, and to fit neatly, so that the interior may be always kept, with the help of the ventilators, of a proper temperature; and this may be easily ascertained by two or three cheap thermometers, which should be hung in the middle of the building, and round the inside of the wall. The three large entrance-doors should be hung by the top, and made to move on friction-rollers, carried by horizontal iron rods across the openings, about 10 feet in height, to give room for the entrance of a loaded cart.

The passage round the interior of the building should be flagged, and under it an air-channel 2 feet deep by 12 inches wide for ventilation, corresponding with a similar channel on the outside of the building. The air from the outside is conveyed through the wall at various intervals in air-channels, but the quantity required from time to time is regulated by dampers moving flush with the inside of the wall, and in an undulating manner escapes in the passages through iron gratings fixed 15 feet apart, which are shown on the plan. Similar air-channels are also represented running between the rails, the air escaping in a like manner by iron gratings, and in this way it is conceived will sufficiently give at all times abundance of fresh air for the cattle confined in the building. On the whole, it will be observed, from the specification and estimate which are hereby given, that the advantage of such a steading, both to landlord and tenant, is reciprocal: for, in the first place, the expense of such an erection as the plan represents, for a large tillage farm of 500 or 550 acres, is about £490 less, exclusive of cartage, than the like accommodation furnished in the usual manner with stone and lime walls; while the compact arrangement will greatly tend to economise the labour of feeding and attending to the stock, and thereby effect a considerable saving of expense to the tenant, when compared with a steading, the various buildings of which are necessarily scattered about, taking up a great deal of room, and consequently inconvenient.

It is important to observe that a farm-steading all under one roof should, for the sake of security, have as few outside doors as possible, otherwise one of the great objects to be obtained by such an erection, next to economy and convenience, would be defeated, by the absence of that security to property which a very few outside doors would give. By this plan, only one or two at most of

the outside doors will require to be opened daily; and this, in designing the plan, has been kept steadily in view from the first. Another important object which has been observed, is the sufficiency at all times of *light* and *air*, by giving the side walls, and roof from which the building is lighted, a good elevation; for a steading on this principle, lighted at the sides, and the walls, say only 9 feet in height, with cramped narrow passages, and inner partitions of stone and lime, the heat engendered by the confinement of a number of cattle must at all times be excessive and injurious, while the temperature, by any plan that may be devised, must undoubtedly be difficult of proper regulation.

SPECIFICATIONS.

The contractor or contractors of the several works to find at his, or their own cost and charge, all materials, labour, scaffolding, and every other expense necessary to complete the work, excepting cartage, which will be provided by the tenant or proprietor.

Mason's work.—To dig trenches for the foundations of walls 2 feet below the surface, or to such further depth as may be necessary to obtain good and sufficient foundations; dig all drains; and urine-tank 12 feet deep by 9 feet diameter.

The foundations of all the walls to be laid with large flat-bedded stones 2 feet 4 inches wide; the walls above the foundations to be 2 feet thick; the outside to be in regular hammer-dressed courses from 6 to 8 inches high, two courses of walling to be the height or one course of quoins. All the inside walling to be good common rubble, and to have a sufficient number of through stones so interspersed as there will be one through to every superficial yard of walling. The whole to be well filled with mortar composed of good well-burnt clod lime, and clean sharp sand, and using not less than one cart of lime and two carts of sand, properly beaten together with water, to every 18 superficial yards of walling. The inside of walls to be dashed, and the outsides to be neatly drawn pointed.

All the external angles of walls to have drafted and broached quoins 1 foot 9 inches long, and 9 inches on the head, and to be the height of two courses of walling. All the outside doors to have stone cases drafted and broached built in and out ties. The in-ties, to go through the full thickness of the wall, to be 9 inches on the head.

The out-ties to be 1 foot 9 inches long, and 9 inches on the head, to be properly checked for doors. The crooks to be run in before they are set; the mason to find lead for the same. All the windows to have drafted and broached heads and sills. The heads to be 1 foot deep, and to have 1 foot wall-hold at each end. The sills to have proper drips, and to project 1½ inches from the face of the wall. All the gables to have chiselled stone water-table, with saddle top; to be well jointed; the first stone to be worked on the corbel quoin. A round ridge-stone to be worked to a mould, and laid straight on ridge, and well pointed down to the slates.

The stone bases to metal pillars to be 2 feet square, and 1 foot 3 inches thick, chamfered at the top, and properly set on rubble foundations. The crib-stones in byres to be chiselled and chamfered on the top, and to stand 6 inches above the flagging. That part of the barn which is not boarded, the straw-barn, engine-house, potato and boiling house, and the cribs of byres, to be flagged with strong 2-feet natural-faced flags, properly squared, and well bedded in sand, and jointed with lime. The stables, byres, calf-cribs, cattle-boxes, passages, bull-house, work-shops, infirmaries, &c. to be paved with rough hammer-dressed stones, 8 inches deep, in regular courses, and well bedded in sand. Air-drains to be built as shown on drawings, and to have cast-metal gratings fixed above them at proper distances. The flues or drains through the walls to have a damper fixed close to inside of the wall, to work with the valves of ventilators in the roof. The walls of barn, granaries, engine-house, stables, and boiling-house, and the whole inside of the outer wall, to be plastered with one coat of plaster.

To furnish and set with proper grates and fire-bricks two boilers in boiling-house. The engine-chimney to have stone base and cornice; the remainder to be of bricks, and the engine-boiler to be set with fire-bricks. All the drains leading to the urine-tank to be laid with good glazed socketed pipes, and cemented at joints. The urine-tank to be walled and arched with well-burnt bricks; to have a man-hole with stone cover at the top; to be plastered with Portland cement, and left water-tight. Railways to be laid, as shown on the plan, along the different passages, for conveying food to the stock, and taking away the dung to the dung-yard. The rails to be constructed of the best wrought-iron, and fixed by metal chairs to large blocks of stone, with the necessary turn-tables and switches. To run in all crooks, catches, &c., and to cut all holes for plumber, carpenter, and joiner's works.

Carpenter's and Joiner's Works.—The timber for all the lintles, roofing, flooring, joists, door-frames, doors and windows, ventilators, barn fixtures, to be good Memel timber. The flooring to be Norway battens. The whole to be free from sap, shakes, and dead knots. The stables and byres to be done with oak and Memel timber. The calf-cribs and cattle-boxes to be fitted up with strong larch-fir poles not less that 4 inches diameter at an average. Lintles to be 1 inch of thickness to every foot of length, and to have not less than 1 foot wall-hold at each end; to be the breadth required. All the inside-door openings to be lintled over the full thickness of the wall. The roofs to be framed as shown on drawings, with two ribs on each side.

The principals to be not more than 7 feet apart; the spars to be laid edge up, and 16 inches apart from centres. A course of $\frac{5}{8}$th-inch sarking, 7 inches wide, to be laid along the eaves, and on each side of ridge. The roof to be supported by beams fixed to the tops of pillars. To have hollow metal pillars 20 feet

apart, and metal sky-lights. Ventilators to be fixed where shown on drawing, each 3 feet by 2 feet. The cords that work the valves of ventilators to be brought down the walls, and fixed to a damper in the air-drains, and to be so constructed as both to open and shut together. All the sky-lights and ventilators to be properly flashed with lead, and made water-tight.

Scantlings of Timber.

Principal rafters, 7 by 2½ inches.	Ribs, 5½ by 3 inches.
King-posts, 7 by 2½ inches.	Ridge, 7 by 1¼ inches.
Struts, 3½ by 2½ inches.	Spars, 2½ by 2¼ inches.
Binders (one on each side), 7 by 1¼ inches.	Wall-plates, 7 by 1¼ inches.
Longitudinal beams, 12 by 6 in.	Barn fixtures, 12 by 6 inches.

The horizontal gutters to be boarded with 1¼-inch grooved and tongued Memel deals; to have declivities and proper drips, as shown on the plan; to be nailed to bearers 2½ inches by 2½ inches, and 16 inches apart. The valley gutters to be laid with ⅝ inch by 9 inches Memel deals, nailed to the spars. Doors to be 1¼-inch batten doors, with three battens on each door; the joints to be grooved, tongued, and beaded. To be hung with strong crooks and hinges; each hinge to be two-thirds the width of the door, and to have two screw-bolts in each. All the doors to have strong ring latches, and plate-bolts where required. The granaries and outside doors to have good stock-locks, of the value of 5s. each. The inside door-frames to be 5 inches by 3 inches, beaded.

Windows to be trellis windows, with two squares of glass in height at the top, and trellis below; the inside trellis to slide to admit the air. Frames 3½ by 2½ inches, trellis 1½ inch by 1 inch, beaded. The windows to be built in along with the walls.

The joists for granary and barn floors to be 9 inches by 3 inches, and 18 inches apart from centres. The ground floor of barn to be 1¼-inch grooved and tongued Memel battens. All the other floors to be 1¼-inch grooved and tongued Norway battens; to be properly tailed and well dressed off. All the floors to have skirtings 1⅛ inch thick and 7 inches deep, well nailed to plugs. The stall-posts and rails to be of oak; the hind-posts to be 5 inches by 5 inches; the fore-posts to be 5 inches by 3 inches. The rails to be 4½ inches by 4 inches; to be grooved to receive 1¼-inch Memel cleading; dressed and beaded joints. To have 1½ inch by 9 inches batten, well nailed on each side. The posts to be fixed in stones at the bottom, and at the top with screw-bolts to girders 6½ inches by 3 inches nailed to underside of binders. The racks to be oak, rails 3½ inches by 3 inches, and rings 1½ inch by 1½ inch, and 3 inches between; to be 3 feet high, and one-third the width of stall on each side of manger. The mangers to have 1½ inch in fronts and bottoms, with 1 inch backs; to be 14 inches wide at the top, and 9 inches at the bottom. To have 2½ inches oak rollers along the front edge and end, and also along the top of the rack. To have an oak post

6 inches square fixed in each stall, with proper rings, staples, &c. Each stable to have a corn bin for every two horses; to have strong harness pin rails fixed as shall be pointed out. Each stall-post to have an iron crook for hanging harness.

The byres to be fitted up as shown on drawings. To have oak posts and rails, and 1¼-inch cleading. The fore-posts to be framed into a Memel girder 6 inches by 6 inches, the full length of the byre. The front of cribs to be 1½-inch Memel deals, 1 foot 10 inches high, fixed to oak posts. Iron sliding-rods, 18 inches long and three-fourths in diameter, to be fixed to the posts, with screw-bolts for cattle bindings. Calf-cribs to have larch fir railings and grates. To have racks and mangers fixed to partitions. Cattle-boxes to be fitted up with larch. The posts to be square; to be fixed into metal sockets 8 inches in height and 7 inches square. Each socket to be securely bolted, with one screw-bolt at each corner, into stones set in the floor level with the surface; no stone to be less in size than 18 inches square and 1 foot deep. The rails to be sawn and put on rough. The permanent rails to be firmly nailed to the posts; the front rails to be fixed so as they may be easily taken out. The rails to be placed as shown on the plan. To have mangers fixed to rails of partitions as shown on drawings.

Plumber's Work.—The valley gutters to be laid with lead 6 lb. per superficial foot, and 1 foot 3 inches in breadth. The horizontal gutters to be covered with lead 6 lb. per superficial foot, to go 12 inches under the slates on each side. To have declivities of 2¼ inches every 20 feet, and 2-inch drips. To have proper boxes, and 3-inch pipes soldered into them, and put through the beam below into cast-iron pillars. The ventilators and skylights to be flashed with 5 lb. lead. The whole to be made perfectly water-tight.

Slater's Work.—All the roofs to be covered with Welsh slates (ladies), laid with sufficient overlap on good Memel laths ⅝ inch by 1½ inch, with copper nails, two in each slate. The whole to be well pointed inside with good hair-and-lime mortar, and left water-tight.

Painter's Work.—All the doors, windows, ventilators, and skylights to have three coats of white lead and oil, mixed to a tint to be approved of. All the windows and skylights to be glazed with strong sheet-glass, weighing 16 ounces per superficial foot. To be well bedded in good oil putty. The whole of the work to be done in a sound workmanlike manner, subject to the inspection and approval of   , or whom he may appoint.

Such a farm-steading as has been described and specified (where stones can be obtained on the estate), can be erected, exclusive of cartages, for £1940. The same accommodation, if built in the usual manner, would cost, excluding cartages, £2430.

JAMES D. FERGUSON.

BYWELL, NEWCASTLE-UPON-TYNE,
17th November 1854.

PATENT REPORT ON REAPING-MACHINES AND THEIR INVENTORS.

(*Continued from page* 623.)

IN our last we gave the date of the patent granted to Joseph Whitworth of Manchester, and which we now proceed to describe.

Mr Whitworth's machine offers a very marked resemblance to that patented by Mr Matthew Gibson in 1846, and already described. In both the cutter is placed on the under side of a revolving hollow drum; in both the distance of the cutter from the ground is regulated by nearly identical means—a hollow shaft and appropriate gear, to raise and lower the drum with its cutter; in both the revolving drum is supported by the same means—in Gibson's by two wheels, in Whitworth's by one. So far as the merely mechanical arrangements go, there seems little to choose between these two contrivances; but in Mr Gibson's there are means adopted to "gather" the corn after being cut; while in Mr Whitworth's there is apparently no provision made for this purpose. This desideratum, therefore, being so completely ignored by Mr Whitworth, excludes, or nearly excludes, his machine altogether from the list of reaping-machines. A machine which can cut only—however well it does cut, no matter—has no more right to be called a reaping-machine than a joiner's plane would have, if it only planed, but could not clear itself of the shavings, to be called an efficient plane. We fear that Mr Whitworth's attempt, eminent a mechanician as undoubtedly he is, is but a corroboration of the truth of the proverb, "*ne sutor ultra crepidam*" (a shoemaker should not go beyond his last). Something more than a thorough knowledge of mechanics is requisite to enable any one to produce a really effective reaping-machine, without a knowledge of the work to be done, and the difficulties attendant thereupon. This, indeed, gives the key to the "reason why" so many inventions have been brought out in this department, nearly all of which have been thorough failures. We believe the problem will be solved by one who, to a knowledge of practical mechanics, adds that of field-husbandry.

It is but right to state that, by an elongation of the shaft of the hollow cutter drum, and causing it to revolve in a direction opposite to that in which it revolves when cutting grass and crops that require spreading, Mr Whitworth proposes to lay the corn in a position more convenient for gathering. In place of a circular cutter, he also proposes to substitute curved blades or scythes, as shown in the Plate (fig. 10 *a*).

In the patent granted to Mr Joseph Burch (23d June 1853, dated December 24, 1852), of Craig Hall, near Macclesfield, there is a novelty in the method by which the cutting is performed.

Two discs revolve horizontally, to the peripheries of which cutters or sickles are attached, and from which they project. These discs being placed in juxtaposition, revolve in *contrary* directions. The sickles operate on the crop like the continuous stroke of a scythe; and by crossing each other as the discs revolve, the cutting edges alternately come in contact, and have the effect of revolving shears. The centres of the two discs are placed about an inch and a half apart. By this means, the sickle points, on the advancing side of each disc-cutter, shall project, for the purpose of effectually gathering in and cutting the crop as the machine advances. The disc-cutters revolve by the action of the large supporting wheels, these being placed in a cranked axle, at a lesser distance from each other than is described by the diameter of the sickle points. The machine is moved in the same way that canal boats are dragged along—a pole being placed in the front, to which the rope is attached, this being high enough to enable the rope to clear the corn. It may also be pushed forward, being guided by means of a handle, actuating two guide-wheels beneath the disc. In fig. 12 we give a front view of the two discs, with the sickle points.

On December 1, 1851, a patent was granted to William Exall, of Reading, the well-known agricultural-implement maker, for an improved reaping-machine. The cutters in this are placed upon an endless band or chain revolving round two rollers. A row of holding spikes project in front of these, the cutters passing through these nearly at right angles (see fig. 16 in the Plate). The "gathering" is effected by a novel arrangement of travelling-cloths. Immediately behind the cutters and spikes, an endless web or cloth is placed, running in the direction of the length of the machine, or at right angles to the line of cutters. The corn as it is cut falls upon this, and is carried on towards the back of the machine. It is then delivered to a second endless cloth, moving at right angles to the first cloth. This second web deposits the corn at the side of the machine.

The machine is drawn forward, the pole with the whipple-tree being placed at the side in front.

Where the material to be cut is short and slippery, and the weather windy, the travelling-cloths are dispensed with, and a "collector" substituted. To the axle which constitutes the frame or support of the collector, are attached two wheels, on which the collector runs behind the machine. To this axle a swinging frame is also attached, which frame is provided with tines; a scraper also moves upon the axle of the collector. The tines are raised and the scrapers depressed simultaneously, by means of connecting-rods, which are connected with a lever, having a fulcrum at a standard attached to the axle of the collector.

We have now to notice a series of machines, the cutters of nearly all of which are upon the reciprocating principle. These

offer but little diversity in their arrangement; indeed, so close a similarity exists between a large per-centage of their number, that an inspection merely of the drawings in the Plate will convey all the information that seems desirable. We shall, therefore, content ourselves with directing attention to these as we proceed, leaving the bulk of our remaining space to the description of the methods by which the corn is gathered or collected in the various machines under notice. In this department we have some novelties to draw the reader's attention to, which may afford some practical suggestions.

The next machine we have to describe is that of George Stacy, machinist, of Uxbridge—the date of the patent being January 24, 1852. The arrangement of the cutters is shown in fig. 17 in the Plate. The blades or knives work on centres or joints in the bar *a a*, the ends being jointed to the movable bar *b*, which has a reciprocating movement given to it by the crank *c*. The following is the mechanism of the gatherer or collector. The corn, as it is cut, falls upon an endless cloth or travelling-apron placed immediately behind the cutters. The direction in which the cloth moves is at right angles to the line of cutters. The apron is supported upon endless chains passing round rollers. Motion is given to the roller by a click working into a ratchet-wheel upon one of the rollers. This click being attached to the connecting-rod which works the cutters, the moving of the apron is thus in proportion to the operation of the cutters. The corn thus received in the apron is discharged by any of the ordinary modes of self-delivery for such purpose.

The next patent we have to notice is that granted to William Dray of London, agricultural-implement maker, January 27, 1852. This is the machine so well known as *Hussey's*. The arrangement of the cutters with the projecting fingers is shown in fig. 18 in the Plate. In the specification, several methods for collecting the cut corn are described. First, When the corn is cut, it falls backward upon a platform, and is then pushed back to an additional table or platform. From this second table it is raked on to the ground at the side in the rear of the road-wheel. The second table may be dispensed with, and the bundles of corn dropped directly on to the ground, but to the rear of the cutters in place of the rear of the road-wheel. To facilitate the raking, the road-wheel is covered with a box, which forms a seat for the raker who draws corn from the first to the second table, as well as for the raker who draws the corn from the second table to the ground. The second method described is as follows:—The main platform is diminished in width to about 12 or 16 inches. A swinging crane is fixed in the platform, being formed by an upright post and a horizontal arm. The upright post can be moved in its gudgeon by means of a handle projecting from it, and which is placed within the reach of the operator. The position of the arm

of the crane is about two or three feet behind the cutters, and about a foot from the ground. The crane bar is swung parallel to the cutter bar, in order to receive the corn. On a sufficient quantity being cut, the attendant swings the crane out backwards, permitting the corn to fall on the ground. It is then returned to its former place, ready to receive another lot. The sheaf on the crane is separated from the falling corn by the attendant with a stick. The part of the crane which receives the corn is placed inclined, so as to disengage the sheaf all the more readily. The third method is as follows:—In place of the crane above mentioned, a tilting platform is used. This is hung by gudgeons in or near the middle of its ends, holding it parallel with the cutter bar. The gudgeons, or centres in which the platform works, are placed at such a height above the cutter bar, that when one edge of the tilting platform rests on the cutter bar, the other edge is considerably elevated. When the machine is working, the edge of the platform rests on the cutter bar. As soon as a proper quantity of corn is delivered to it, the attendant takes hold of a lever handle, projecting at right angles from the face of the platform, and tilts it over. The sheaf then slides off, and the lever being released, the platform returns to its former position. The inventor states that the two last methods are particularly useful in heavy crops. We should think that the corn cut in the interval between the delivering of one sheaf, and the return of the crane or tilting platform to its position, would be difficult to be got rid of, and would impede the action of these gatherers. Mr Hussey also in his patent proposes to use the revolving reel, to assist the heads of corn to fall regularly backwards.

In the patent granted to Ralph Ridley, Hexham, tanner, February 9, 1852, the cutters are on the reciprocating principle, as shown in fig. 19 in the Plate. There are two sets, one being movable, the other stationary. The stationary cutters are screwed on to the projecting pieces *a a*. Between these are circular holes *b* for the pivots of the moving knives to pass through. These holes open into square recesses, in each of which is fitted the square head of a bolt and a spiral spring. This latter rests on the head of the bolt and the upper side of the recess. The bolt passes through the round hole *b*, and the moving knife is made fast to it. The moving knives are shaped in their cutting part exactly like a scissor blade, slightly curved to the point towards the scissor blades. If the moving knives were held firmly and rigidly by the square-headed bolt previously mentioned, they would not move; if, on the contrary, they were loose at the pivot, to allow the curved part to rise, then they would cut at the points only. The springs are made sufficiently strong to secure a pressure upon the knives that will make them cut, while they allow the curved knife to rise, by which means the edges of the two knives are kept in contact,

and consequently cut throughout their whole length. The spring in this machine yields exactly as the hand does when using a pair of scissors.

The gathering apparatus is as follows. It presents many points worthy of notice. At right angles to the line of cutters, and immediately behind them, are four rollers, one pair at each side of the machine. Each pair is connected by endless chains, one of the rollers receiving motion from a small toothed wheel. An endless belt or apron is attached to each pair of rollers. The distance between the pairs of rollers is such, that a space is left in the middle of the machine, between the two endless aprons. The motion of the belts or aprons is at right angles to the line of cutters, and towards the centre of the machine. As the corn is cut, it falls on the endless aprons at each side of the machine in the direction of the length of the corn. The aprons take it to the centre of the machine, where it falls to the ground between the two aprons. The corn is thus laid in continuous lines. To lay it in bundles, however, a very simple yet ingenious arrangement is carried out. Suppose a board is placed below each endless apron, their edges coming in contact exactly in the centre of the open space between the aprons. It is obvious that so long as the boards remained together in contact, any corn falling from the aprons would be supported in them, and prevented from falling to the ground. But suppose the boards to be moved, so as to make a space between their edges equal to the space between the aprons, the corn would then fall to the ground. If the boards were then closed, more corn would be collected in their upper surface, which, by moving the boards from each other, would fall to the ground. By doing this at regular intervals, the corn would be delivered in bundles. This, then, is the principle of the gatherer. It is carried out as follows:—To the main driving axle or shaft of the machine, a crane or eccentric is fixed; this, as it revolves, acts upon a small friction-wheel attached to a horizontal lever, which by this means receives a reciprocating movement. The short arms of two bent levers are attached by a slotted opening to the end of this horizontal lever. The long arms of the bent levers are attached to the boards, which are placed within the endless aprons before described. These boards slide upon pieces of angle iron, and have their movement to and from the centre of the machine. Two supports are attached vertically to the frame near the front of the machine. These supports are bent forwards, so as to come just above the points of the cutters. Bearings slide in slots in the upper part of these supports, and are capable of being adjusted to any height required. The shaft of a gathering-wheel or reel is supported in these bearings. The axle which drives the cutters gives motion at the same time to the revolving wheel. The periphery of the gathering-wheel moving one-third faster than the periphery of the

main driving-wheel, for each revolution of the driving wheel, the corn which moves the collecting boards makes six. The boards, therefore, move six times out and in during one revolution of the driving-wheel. Each revolution moves the machine forward about 12½ feet. Each delivery of the boards will therefore give, in one bundle, the quantity of corn standing on a space 2 by 6 feet. The endless belts travel at the same rate as the machine. The movable knives move eighteen times, making thirty-six cuts for each revolution of the main driving-wheel.

In the patent granted to Moses Poole, London (being a communication from a foreigner residing abroad), July 6, 1852, the cutters are on the reciprocating principle, as shown in fig. 20 in the Plate; the peculiarity in the cutters being, the formation of a recess in a projecting guard. Into these recesses may pass such portions of the material as are cut, and thus prevent the choking of the cutters in the projecting guards. These recesses are all cleared of such materials by the action of projecting studs fixed to the under side of the cutter bar. A drawing is given of a machine on this principle of cutter for mowing grass, in which the machine is worked by a crank and appropriate gearing, the attendant being carried along with the machine as it progresses; a belt passing from a drum on the crank axle to another drum on the axles of the wheels, the attendant working the cutters and propelling the machine at the same time.

Fig. 12 shows the form of circular cutter used in the machine patented by William Smith, farmer, Bucks. The inner edges of the blades being toothed or notched, angular projecting fingers are placed before the cutters. A square recess is placed between each pair of fingers, the inner angles of these being provided with fixed cutters, with which the revolving cutters work in contact. The straw is made to incline *from* the machine when the cutter comes up to it, this inclination being effected by a bar, capable of adjustment at any angle, projecting before the machine. The corn, as it is cut, is gathered, or deposited at the side of the machine, by an endless cloth or web, working at right angles to the line of direction of the machine, this web having projections on its outer surface. As the web revolves in front of the cutters, these projections catch the corn and deposit it at the side.

In the machine patented by John Reid Randall, farmer, of Cornwall, October 7, 1852, the cutters are on the reciprocating principle, and work between a cleft made in the projecting fingers (see fig. 21). The width of this cleft is very little larger than the thickness of the angular cutter; so that, whilst the cutters are in action, their rubbing against the interior of the teeth or fingers keeps them always in a sharpened state. The corn is brought up to the cutters by a gathering-rod, and laid on a platform, from which it is taken

and delivered to the ground by a "raker," who stands on the platform.

In fig. 22 we show the form of reciprocating, patented by Mr M'Cormick, October 14, 1852 (by Mr Brooman, of London). This patent comprises improvements and modifications in the machine previously patented in 1850, and already described; the form of cutters in that machine being as in fig. 15 in the Plate. In the patent now under consideration, the machine rests upon a shoe or skate placed immediately behind the cutter-bar. By means of this shoe the cutters are allowed to work nearer the ground. A scraper-board or side-shield is placed behind the shoe, the purpose of which is to clear the track of the cut grass, so as to enable the horses to turn without treading on it. The cutters are inserted in slots made in the projecting finger-bars (see fig. 15). Openings are made in this, both above and below the cutters, by which choking is prevented. Where the machine is used for grain, the reel, which is used in the grass-mowing machine, is thrown more forward. The grain is laid on a platform as it is cut. To the side-frame two dividing-irons are fixed, and a separator is used for dividing the cut from the uncut grain.

In the patent granted to Henry Smith, Stamford, agricultural-implement maker, Dec. 11, 1852, the cutters are on the revolving principle. They are not, however, circular, but star-shaped, as shown in fig. 14. They are made to revolve by an endless chain passing round pulleys fixed on their under side. The cutters cut up against a stationary edge, and projecting fingers *c* guide the corn to the cutters. The stationary cutting-edge is placed immediately above the revolving cutters *a a*. The corn is delivered in certain quantities, not continuously. This is effected as follows:—A revolving reel, moving simultaneously with the cutters, sweeps the cut corn on to an inclined platform behind the cutters. At the farther end of the platform a roller is placed. This roller does not move continuously, but has an intermittent revolution. The quantity of corn delivered to the ground from the platform corresponds to the time in which this roller revolves. The intermittent revolution is effected by a combination of levers and straps, the strap or belt which drives the roller being moved alternately to the periphery of a fast and a loose pulley, the belt or strap being placed between the forks of a lever which has a reciprocating motion given to it by a cam fixed upon the driving axle of the gathering-wheel. When, therefore, the belt of the roller is on the fast pulley, it revolves, but when it is on the loose, there is no motion. To effect a side-delivery, the method above described delivering the corn behind the machine, a suspended rake has a swinging motion given to it by means similar to the above. The motion of the rake is at right angles to the direction in which the machine progresses.

The next patent granted is one to Moses Poole, dated October 2, 1852. Like the one granted to the same gentleman, already described, it is on behalf of Mr Hussey. The improvement patented consists mainly in bringing the cutting apparatus nearly in a line with the main axle, so that in crossing ridge and furrow the cutters and main wheel rise and fall together. By this arrangement a difficulty hitherto experienced is obviated. The fingers are of cast-iron, but the method of chilling the surface of the slots in them, so as to harden the surfaces on which the cutters play, is claimed as novel. Spurs fixed to the under side of the cutter, and playing inside the cavities of the fingers, in order to clear out foul matter accumulating under the cutters, is also claimed.

In the patents granted is one to Mr Ridley, being an improvement on the patent machine described in fig. 19. In this the motion of the bars is produced by a cam-wheel instead of a crank. When the corn is cut it falls back upon a board immediately behind the cutters. This board rests on a hollow axle, and is tilted at intervals so as to bring the corn in contact with the ground, when it is dragged off. This tilting of the board is effected by a lever, which is actuated by a wheel on the main axle striking a projecting pin.

Figs. 23 and 24 in the Plate represent the cutters on the reciprocating principle of the patent granted to William Crosskill, of Beverley, 5th October 1852. The principal feature claimed is the placing the front or cutting part of the machine on small wheels, in a line with, and as near as convenient to, each end of the cutting apparatus. By this arrangement, the distance between the cutters and the ground is always the same. To prevent the corn from being thrashed out during the process of reaping, brushes or other soft elastic substances are attached to the end of the revolving rake, by which the corn is brought up to the action of the cutters.

In the patent granted to William Dray, October 5, 1852, the corn, after being cut, is received on an endless band or strap, made up of angular bars, which carries it up on an inclination, and drops it on to inclines, so arranged to let it fall either immediately behind or at one side, and at intervals or continuously. For the form of cutter, see fig. 25.

In Mr Fowler's patent (No. 428), the principal novelty consists in the application of a fan or fanner placed in front of the machine, by which a strong current of air is directed against the corn in front, so as to lay it against the cutters. We fear that more power will be expended in working the blast, than will be returned in useful effect. As the corn is cut, it is received into a platform formed of bars, with spaces between them, transversely to the machine. Bars are placed below this platform, with points or forks, which are caused to fold out and rise up above the platform,

and move the cut corn to one side of the machine, then to fold down, and to pass to the other side, again to come into action.

In Mr Newton's machine (No. 579), the sickle or cutter runs through, and acts in concert with a series of guard fingers, secured to, and projecting forward into the standing grain or grass. The rising of the fingers over the inequalities of the ground is facilitated by making their points turn upwards. When the cutter is placed in the rear of the fingers, and moved back and forward by the crank, each of its teeth will pass from the middle of one finger to the middle of the adjacent finger alternately, so that the teeth will press the stalks alternately towards and from each side of the fingers.

In Mr Phillips' patent (No. 626), the principal points claimed refer to methods of gathering the corn after being cut, and depositing it in regular bundles, ready to be tied up into sheaves. One of the methods claimed is by the use of an endless web, on which the corn is conveyed to the best points of discharge. This web has an intermitting movement given to it, so as to deliver the corn at intervals corresponding to the quantity required. The movement of the web is made to correspond with the movement of the machine, and consequent quantity of corn cut, by ingenious but somewhat complicated mechanism—a description of which here would take up more space than we can devote to it. Another point claimed, is the use of cords or bands passing under laid or fallen corn, and which, running upward and backward at a suitable angle, raises the corn and places it at a suitable inclination for falling as would be desirable when cut.

The patent of Mr Johnson (No. 726) refers to the reaping-machine now attracting so much attention amongst farmers, and known as "Atkins' Self-Raking Reaping Machine." It is characterised, by an able authority in mechanical matters, as "a very extraordinary piece of mechanism, rivalling even the 'copping motion' of the self-acting (cotton) mule in intricacy and beauty of action." The inventor is Mr Learum Atkins, of Chicago, Illinois, formerly a mill-wright, but now a "crippled and disabled man." As will be noticed in referring to fig. 30 in the Plate, the cutter is peculiar. The knife bar is on the upper side, and is placed in the middle of the blade, and as far forward as the cutting angle will allow, instead of being placed, as is usually the case, flush with the back edge. The back of the cutter is formed zigzag, each alternate edge being serrated and bevelled the other way. The knife thus formed is not the invention of Atkins, but of Browson Murray, Esq., of Salle county, Illinois. For several years this gentleman had used reaping-machines, and was much annoyed in rainy weather, or when the grass was wet with dew, by the choking of the knife, and by the time lost in picking out the fingers. The thought occurred to him that, by cutting out triangular

pieces at the back of the knife, and roughly toothing them, the difficulty would be obviated. A trial proved the value of his conjecture. The object accomplished by this form of knife is simply this:—In either reaping or mowing, a fibre hangs upon a finger, and gradually works to the tightest place and is fastened. Another and another works to the same place, a like process being seen on other fingers, till the knife becomes choked and immovable. The Murray knife-blades resting upon the fingers, and the edges in front and rear being in close contact with them, it will be seen that any matter accumulating upon the fingers will be picked off by the sharp points of either the front or rear edge of the knife. It is impossible to choke it.

The following description, extracted from the patentee's provisional specification, will give the reader an idea of the operation of this machine. Without the aid of drawings it is difficult to give a detailed description of the beautiful, and, in some points, essentially novel, mechanical movements involved in its arrangement.

In the same vertical plane with the centre of the axle of one of the running wheels of the machine is fitted a vertical support, having a rocking or partial rotatory motion in a footstep bearing at its lower end, while its upper extremity works in a horizontal pillow block, projecting from the framework of the machine. In a large opening in the centre of the vertical support, and in the same horizontal plane with the centre of a bevel wheel which works on a fixed stud in the framework, is fitted a bent lever, one end of which is connected by a ball-and-socket joint to the inside of the rim of this wheel. An anti-friction roller is fitted to the other end of the bent lever, which works in a slot in the end of a second lever; this lever is connected to the shank of the rake. An iron rod connects the upper end of the rake handle with the upper extremity of the vertical support herein-before described. Beneath this rod is fitted a strong blade-spring, for the purpose of steadying and supporting it as it approaches the lower point of its descent, and preventing the tremulous motion of the rake, which would otherwise occur while it is extended. To the vertical rocking shaft or support is suspended an iron plate, having teeth at its lower edge. This plate is fitted with coiled springs at its hanging centres, for the purpose of keeping it pressed forward.

The action of this machine is as follows:—When a sufficient quantity of cut grain has accumulated on the platform, the rake, which is previously extended by the action of the levers herein-before described, is caused to traverse across the platform, drawing with it the cut grain, and compressing it into a bundle against the sheet-iron plate herein-before mentioned. By a partial turn of the vertical support, the bundle is brought over the back edge of the

platform, and as the rake becomes extended, it is allowed to fall to the ground in the track of the machine.

The support now turns back again, and the rake extended to the further side of the platform, in readiness for another stroke.

The principal features of this invention are the serrated or zigzag cutter herein-before described, and the mode of hanging the rake and operating it from the bearing or propelling wheel of the machine, so that it traverses across the bed or platform from the side next the standing grain towards the side of the machine to which is attached the draft-bar for collecting and compressing the grain against and between a palm or hand, with or without a vibratory movement,—which hand, with the rake, when the grain is thus collected, swings or turns for a quarter of a circle, or thereabouts, thus delivering the cut grain in bundles, at convenient intervals; the rake opening or extending backwards when delivering the grain, and then, together with the palm or hand, turning back for the similar collection of another bundle.

CHRONOLOGICAL TABLE

CHRONOLOGICAL TABLE OF DATES OF PATENTS FOR REAPING-MACHINES.

Illustrated by a Tabular View of the various Cutters.

Number of Patent.	Date of Patent.	Name and Address of Patentee.	Title of Patent.	Illustrated in Tabular View by Fig.	Remarks.
2324	July 4, 1799.	Joseph Boyce, of Marylebone, Middlesex.	A machine for cutting of wheat and all other grain.	Fig. 1.	The cutters cut on their convex side.
2404	May 20, 1800.	Robert Meares, of Frome, dyer.	Machine for cutting, after a new method, standing corn and the like, and for making reed.	Not illustrated in tabular view.	The cutting was performed in this case by a large pair of shears running on wheels.
2859	Aug. 23, 1805.	Thomas James Plucknett, of Deptford, Kent.	A new method of mowing corn, grass, and other things, by means of a machine moving on wheels, which may be worked either by men or horses.	Fig. 2.	A flat disc, with cutting edge on periphery.
3468	July 26, 1811.	Donald Cumming, farmer, Whitefield, Cumberland.	A machine for reaping and cutting corn, grass, and other articles.	Fig. 6.	*a a* the frame; *b* the grinding-wheel; *c c* the fingers.
3844	Sept. 23, 1814.	James Dobbs, of Birmingham (actor).	Various improvements in the manufacturing of machines used for the cutting and gathering of grain and produce arising from the earth.	Fig. 3.	The edge of the circular cutter was serrated. The diagrams to the right show the configuration of the "dividers" and "feeders."

5989	Aug. 31, 1830.	Edwin Budding, of Thrupp, Gloucester.	A new combination and application of machinery for the purpose of cropping or shearing the vegetable surface of lawns, grass plats, and pleasure-grounds, constituting a machine which may be used with advantage, instead of a scythe, for that purpose.	Fig. 4.	The spiral cutters are made of thin steel plates, fastened to three brass rings on the revolving shaft.
8668	Nov. 2, 1840.	John Duncan, Westminster.	Improvements in machinery for cutting, reaping, or severing grass, grain, corn, or other like growing plants or herbs.	Fig. 5.	The cutters or scythes are attached to a circular plate at the bottom of a cone. The scythes are provided with ribs to carry the corn forward after being cut.
8962	May 20, 1841.	Charles Phillips, of Chipping-Norton, county of Oxon, engineer.	Improvements in reaping and cutting vegetable substances, as food for cattle.	Fig. 7.	The cutters are circular, and are driven in pairs; the upper giving motion to the lower. *a a* the cutters; *b b* the fingers.
9812	July 3, 1843.	Do. do.	Improvements in apparatus or machinery for cutting corn, grass, and such like standing crops.	Not illustrated.	Improvements in the mechanical arrangements of the preceding patent, and a method of cutting by reciprocating cutters, similar in arrangement to fig. 13, but *not* in two sets, as there shown.
11,346	Aug. 22, 1846.	Matthew Gibson, of Newcastle-upon-Tyne, machine-maker.	A machine for reaping, cutting grass, and other similar purposes.	Fig. 8.	The knives *a a* are fixed to a circular plate, forming the under part of a cone, supported by and running upon two wheels, *b b*.
11,907	Oct. 14, 1847.	John Scott Lillie, of Fulham, in the county of Middlesex, K.C.B.	Improvements in machinery applicable to tillage and other agricultural purposes.	Fig. 9.	The scythes *b b* are attached to an endless revolving chain, passing round two pulleys, *a a*.
13,398	Dec. 7, 1850.	Richard Arch. Brooman, patent agent, London.	Improvements in agricultural machine.	Fig. 15.	This is the machine known as "M'Cormick's American Reaper."

CHRONOLOGICAL TABLE OF DATES OF PATENTS FOR REAPING-MACHINES—*Continued.*

Number of Patent.	Date of Patent.	Name and Address of Patentee.	Title of Patent.	Illustrated in Tabular View by Fig.	Remarks.
12,907	Dec. 19, 1849.	Joseph Whitworth, Manchester, engineer.	Improvements in machinery, or apparatus applicable to agricultural or sanitary purposes.	Figs. 10 and 10 *a*.	In fig. 10 the cutter is circular, with sharp edge. It is attached to the base of an iron cup *c c*. This is supported by a wheel *a*, which is raised and lowered by the shaft *b*. Fig. 10 *a* shows another form of cutter; *b b* curved cutters, cutting on their curved edges, attached to the revolving arm *a a*.
13,836	Dec. 1, 1851.	William Exall, Reading, engineer.	Improvements in certain agricultural implements.	Fig. 16.	The angular cutters are attached to an endless chain, revolving round the pulleys *a a*; *c* the fingers.
13,910	Jan. 24, 1852.	George Stacey, Middlesex, engineer.	Improvements in machinery, for reaping, mowing, and delivering dry or green crops.	Fig. 17.	A double set of cutters are used in this; one of which is movable on centre pins fixed in the bar *a a*, and worked by the lever and crank *c b*; the other is fixed.
13,924	Jan. 27, 1852.	William Dray, agricultural-implement maker, London.	Improvements in reaping machines.	Fig. 18.	The cutters *c c* have a reciprocating motion given to them by the crank and rod *a b*; *d d* projecting fingers.
13,962	Feb. 9, 1852.	Ralph Errington Ridley, Northumberland, tanner.	Improvements in cutting and reaping machines.	Fig. 19.	The movable cutters vibrate on the centres *b*, worked by the rod *c*. The movable cutters work between stationary ones, as in the diagram.
14,201	July 6, 1852.	Moses Poole, of the Patent Office.	Improvements in reaping and mowing machines.	Fig. 20.	The cutters *b* have motion given by the crank. On the under side of the guards *c* recesses are cut through which the material passes, which might otherwise choke the cutters.

14,296	Sept. 18, 1852.	William Smith, of Little Woolstone, Bucks, farmer.	Improvements in machinery for reaping.	Fig. 11.	A series of six circular cutters, similar to fig. 11, are arranged in a line, and are moved by an endless chain passing round pulleys fixed on their shafts.
14,319	Oct. 7, 1852.	John Reed Randall, Newlyn East, Cornwall, farmer.	Improvements in cutting and reaping machines.	Fig. 21.	The guard teeth *c* are cleft, the cutter *b* working to and fro in the cleft.
14,321	Oct. 14, 1852.	R. A. Brooman, patent agent.	Improvements in mowing, cutting, and reaping machines.	Fig. 22.	This is an improvement in M'Cormick's machine.
79	Oct. 1, 1852.	Henry Smith, of Stamford, agricultural - implement maker.	Improvement in reaping machines.	Fig. 14.	The cutters *a a* are star-shaped, and lap over each other, presenting a continuous cutting edge. They are made to revolve by an endless chain passing over driving pulleys; *c c* guiding fingers.
169	Oct. 2, 1852.	Moses Poole, on behalf of Mr Hussey, of America.	Improvements in machinery for mowing and reaping.		Cutters similar to fig. 21. They are placed nearly in a line with the main axle, so as to rise and fall with it in crossing ridge and furrow.
193	Oct. 2, 1852.	Ralph Errington Ridley, Hexham, Northumberland, farmer.	Improvements in cutting and reaping machines.	Fig. 19.	Improvement in patent No. 14,034, illustrated by fig. 19.
221	Oct. 5, 1852.	William Crosskill, of Beverley, civil engineer.	Improvements in machines for cutting or reaping growing corn, clover, or grass.	Figs. 23, 24.	The cutters *b b* are movable, *c c* stationary. The bearing wheels are placed in advance of the cutters.
245	Oct. 5, 1852.	William Dray, of Swan Lane, London.	Improvements in machinery for reaping and mowing.	Fig. 25.	In this the cutters are made with convex edges, and the clefts in the guides through which they work have also cutting edges.
428	Oct. 21, 1852.	John Fowler, Bristol.	Improvements in reaping machinery.	Fig. 26.	*a a* the cutters, *b b* the projecting fingers.

CHRONOLOGICAL TABLE OF DATES OF PATENTS FOR REAPING-MACHINES—*Continued.*

Number of Patent.	Date of Patent.	Name and Address of Patentee.	Title of Patent.	Illustrated in Tabular View by Fig.	Remarks.
579	Oct. 30, 1852.	Alfred Vincet Newton, of Chancery Lane.	Improvements in machinery for cutting corn, and other standing crops.	Fig. 27.	The front part of the cutters *b b* cut the corn ; the back part, wire grass and other entangling matter.
626	Nov. 3, 1852.	Charles Phillips, of Bristol.	Improvements in apparatus or machinery for reaping or cutting crops of corn, or other crops, to the cutting of which reaping-machines are applicable.		This patent refers principally to the gathering of the corn after being cut, and the formation of sheaves.
697	Nov. 9, 1852.	Obed Hussey, of Manchester.	Improvements in reaping machines.	Figs. 28, 29.	The cutters *b b* (28) have holes or slots *a* cut in them, by which they clear themselves of grass. The blades or cutters work independently of, and do not work in contact with, the fingers *b* (29).
726	Nov. 12, 1852.	John Henry Johnson, of London and Glasgow.	Improvements in reaping machines, and in apparatus connected therewith.	Figs. 30, 31.	The cutters consist of a zigzag knife, having cutting edges at back and front. They play between and cut against fingers *b b*. Fig. 31 shows a knife with undulating edges.
1155	Dec. 24, 1852.	Joseph Burch, Craig Hall, Macclesfield, carpet manufacturer.	Certain improvements in machinery for reaping.	Fig. 12.	The cutters *b b* are attached to two horizontal discs, revolving in opposite directions. The centre of one disc being in advance of the other, the sickle points on the advancing side of each disc-cutter project and gather in and cut the obtruding crop at each side as the machine advances.

THE FARMERS' NOTE-BOOK.—No. XLVIII.

Notes on the Weights and Breeds of Calves.—There are few localities in France where attempts are not now made to improve the breeds of cattle, either by the judicious selection of parents, or by crossing with foreign breeds. But it is not sufficient to hope to obtain by these trials animals of better shapes, and possessing a greater aptitude for labour, or better milking or feeding qualities; it is also necessary to try and produce those which can be soon brought to maturity. This quality, which is reckoned of so much importance by English breeders, from its allowing of the quick turning over of the farmer's capital, is now engaging the attention of those in France who are devoting themselves to the improvement of the breeds of cattle.

It is with the view of seconding the efforts of these gentlemen that I now publish the facts which I have observed both at Grand-Jouan and at Grignon, on the weights of calves at their birth, and also their increase in weight in the first stages of their existence. I indulge the hope that these observations, which confirm the experience of others, may be considered useful by these practical gentlemen.

It is generally admitted that the weight of a calf at its birth is to that of its dam as 1 is to 10 or 12; but this proportion varies much according to the size of the bull and the condition of the cows. The breed has also considerable influence.

The following table shows the weights of fifty calves of different breeds, and the proportion between them and those of the cows which produced them:—

Breeds.	Mean weight of the cows.	Number of calves observed.	Mean weights of calves at their birth.
	lb.		lb.
Durham, ...	1036	7	72
Devon, ...	886	4	59
West Highland, . .	1060	2	74
Hereford, . . .	891	2	61
Schwitz, ...	1408	8	114
Durham-Bretoune, .	792	7	66
Durham - Schwitz - Normande,	1192	4	88
Schwitz-Normande, .	1364	5	82
Bretoune, . . .	605	8	66
Choletaise, . . .	959	3	68
Average,	1019	50	75

Breeds.	Mean proportion between the weight of the calf and that of its mother.	Maximum proportion.	Minimum proportion.
Durham, . .	1.14	1.14	1.14
Devon, . .	1.15	1.12	1.17
West Highland, .	1.14	1.12	1.16
Hereford, . .	1.14	1.11	1.17
Schwitz, . .	1.12	1.08	1.14
Durham-Bretoune,	1.11	1.09	1.14
Durham - Schwitz - Normande,	1.13	1.11	1.18
Schwitz-Normande,	1.14	1.11	1.16
Bretoune, . .	1.09	1.07	1.11
Choletaise, . .	1.14	1.12	1.16
Average,	1.13	1.10	1.15

I will be asked if the male calves were at their birth heavier than the female. This is a question I am not prepared to answer from the observations made by me, as in all the breeds on which the observations were made, the difference was only about 2.2 lb., sometimes in favour of the males, sometimes in favour of the females.

If there is a difference in the weights of calves at their birth, there is a still greater difference in the increase of their weights during the time they are fed on milk; and it is no rare occurrence to find calves, relatively smaller, soon attain a greater weight than others born larger. The food of these animals during the first month consists almost solely of milk, either drawn directly from the cow, or taken from a pail. The calves on which my observations were made were reared from the pail. At first they got 5, 7, 9 pints of milk per day, and after the second week that quantity was increased to 14 pints per day. This was continued to the end of the third month; after which the cream was taken off the milk, and the quantity gradually diminished from week to week, till the milk was wholly taken from them about the commencement of the fifth month. But as the 14 pints of milk were not sufficient nourishment for a calf two months old, a little hay was given in addition, which was increased in quantity according as the milk was reduced in quality or quantity.

According to M. Boussingault, calves, to which 14 pints of milk per day were allowed, increased daily in size about 2.27 lb. during the time they got milk after the second month. MM. Perrault, of Jotemps, have found that, with 19 pints of milk, they obtained a daily increase of weight of about 3 lb. From these observations it follows that we may calculate on an increase of weight of about 2.86 lb. per day from 15 to 19 pints of milk. These results agree generally with those admitted in practice.

I may observe, however, that experience often admits of our counting upon more favourable results. For instance, there is at

present at Grignon a calf of the Schwitz-Normande breed, which increases daily 2.7 lb., and gives an increase of 2.2 lb. for every 10.56 pints of milk. This animal consumes every day 14 pints of milk.

But it is not sufficient to bear in mind the daily increase of the calves; we should also calculate what has been their average increase during the first months of growth. The following are the results at which I have arrived at Grignon. The calves under experiment consumed 14 pints of milk:—

Breeds.	Number of calves observed.	Daily increase the first month.	Quantity of milk for 2.2 lb. of increase.	Daily increase the second month.	Quantity of milk for 2.2 lb. of increase.	Daily increase the third month.	Quantity of milk for 2.2 lb. of increase.	Daily increase the fourth month.	Quantity of milk for 2.2 lb. of increase.	Mean daily increase.
		lb.	Pints.	lb.	Pints.	lb.	Pints.	lb.	Pints.	lb.
Schwitz, . . .	6	1.23	25.2	1.93	16.0	2.08	14.8	1.89	16.4	1.78
Normande, . .	2	1.89	16.4	2.20	14.1	2.52	20.2	1.46	21.1	1.76
Durham-Schwitz-Normande, .	5	1.72	17.8	1.95	15.8	1.98	15.7	1.98	15.7	1.90
Ayr, . . .	1			1.05	29.9	1.79	17.2	1.26	24.5	1.35
Average,		1.61		1.78		2.09		1.65		1.70

The results of this table, as regards the increase in the weight of animals, correspond with those generally admitted—viz. that 17 pints of milk produce about 2.2 lb. live weight. The figures in the third and fifth columns are not quite exact, as the calves received from 2.2 lb. to 4.4 lb. each, per day, in addition to the milk. The quantity of hay consumed by each animal being the same, the figures are still valuable as a comparative experiment. They prove, besides, that after the third month milk becomes less necessary than hay or other forage.

In another experiment, 14 calves of different breeds, from 30 to 50 days old, received on an average 14 pints of pure milk each per day, for a period of 540 days—that is, at the rate of 38½ days for each calf, and gained each about 1.9 lb.; that is, at the rate of 2.2 lb. for every 16¾ pints of milk consumed. It will be observed from the above table, that the Durham-Schwitz-Normandes made the greatest mean increase. The Ayrshire calf was not put up for experiment till 40 days after its birth.

It would not do to conclude from these figures that all calves give results as advantageous. As the race has a sensible effect on the increase in early age, so the individuality of the animal exercises also a marked influence. Among those on which I experimented, some were bad drinkers, others were sickly, and thus the development was in them much less rapid. As in general the

early maturity of a breed is hereditary, we ought to have particular regard, in the choice of parents, to those animals which possess this quality in a high degree.—(CH. MATHIS, Professor of Zootechny in the Imperial School of Agriculture at Grignon, in *French Journal of Practical Agriculture.*)

Green-Manuring.—There is no subject so interesting and important to the scientific and practical agriculturist as the relations subsisting between the animal, vegetable, and mineral kingdoms. In fact, the successful prosecution of his business may be said to be based on a knowledge of these relations, whether that knowledge be empirical or derived from a study of scientific principles. The gradual operations of nature in forming and enriching soils, in the successive growth of different kinds of vegetables, and in the rearing of animals in localities varying as their habits, discover to the farmer the secrets of his business; and an intelligent observation only is wanting on his part to note and appreciate them. His soils and subsoils, he will find, are at first but a storehouse for the mineral constituents of vegetables, of which only the lowest in the scale can flourish in them. The tiny lichen, for instance, as it covers rocks and poor soils with its thin crust of variegated colours, insignificant and useless as it may appear, holds an important place in the vegetable kingdom, as it is the first living thing which prepares the soil for the growth of those vegetables so essential for the existence of man and animals. It dies, and on the elements of its decomposition rises another class of plants, larger in size and more vigorous in growth; these again are succeeded by another class still higher in the scale of vegetation. Thus generation after generation, as it dies out, adds to the soil those elements of fertility of which it was at first deficient—viz., its organic constituents. Having now arrived at what relates particularly to the subject to be treated of in these Notes, we need not prosecute farther the dependence and relations among animals, vegetables, and minerals; we need not show that, as one vegetable succeeds another, so the same order of succession goes on among animals, first herbivorous, then carnivorous; and that the products of the decomposition of all organic beings are for the most part employed to enrich soils, and minister to the growth of succeeding animals and vegetables.

Green-manuring is but the carrying out of that process by man which we have described above as performed by nature in forming and enriching soils. Every plant draws the most of its organic elements from the atmosphere and water, and all its inorganic or mineral, and the rest of its organic elements, from the soil. If, therefore, the plant be ploughed into the soil on which it grew, as none of the mineral elements are lost during its growth, not only are all of them returned to the soil, but a great part of the organic

constituents derived from the atmosphere. When nature is working, the plant is allowed to reach maturity, die, and be decomposed where it grew. It is evident that there is here a great loss; for during decomposition, from the stem and leaves of the plant being exposed, the principal part of its organic matter is again given off to the air in the form of carbonic acid and ammonia. But there is also considerable loss from allowing the plant to become quite ripe, for it is not then so rich in organic matter, no small portion of it being exhaled by the leaves and flowers, as is abundantly evident from the fragrance of a full-blown flower, which is caused by the exhalation of ammonia. It is important, then, for a farmer wishing to practise green-manuring, to plough down the plant at that stage of its growth when it is found to be richest in organic matter, which is just before the blossom has been fully expanded. But there is another advantage in making use of the plant at this stage of its growth. Water is especially necessary for the decomposition of organic matters. A stack of grain or hay heats mainly because decomposition has commenced, from the moisture not being sufficiently expelled before the grain or hay was stacked. At no stage of the growth of the plant is there more water present to facilitate the decomposition, and thus render the plant available as manure for a crop, than at the period of flowering.

We have thus seen that the soil must be considerably enriched in organic matters by green-manuring. And though there is no increase in the mineral elements in the soil and subsoil, still they are searched out in the subsoil by the roots of the plants grown for manure, and presented in the soil in a form more available as food for the crop to be raised. The great object of pulverising the soil and exposing it to the atmosphere, is to bring its mineral elements to this state; so that the roots of the green-manure plants silently effect what the ploughs, harrows, and grubbers are employed to produce. On this subject Professor Way has some very pertinent remarks. "If," says he, "instead of leaving the land exposed only to the action of the atmosphere, we crop it with a plant whose roots run in every direction for food; and if, when this plant has arrived at considerable growth, we turn it into the surface soil, we have not only enriched the latter by the elements derived from the air, but also by matters both mineral and vegetable fetched up from the subsoil. The plant thus acts the part of collecting the nourishment for a future crop, in a way that no mechanical subsoiling or trenching could effect."

It will be obvious, from what has been written above, that the plants best adapted for green-manuring are those whose roots penetrate deepest and ramify most, and whose leaves, from their size, draw most nourishment from the atmosphere. As green-manuring should be practised only after the land has been cleaned,

it is necessary that the plants selected for the purpose be of rapid growth, so that sufficient time be allowed for them to reach the proper stage of their growth to be ploughed down, and to be in some measure decomposed before the crop is sown. It is also of importance that the plant employed should cover the ground well, for reasons which we will give presently. The plants used for this purpose are tares, clover, rape; and, on the Continent, white lupins, spurry, rye, and buckwheat in addition. In the south of England the white mustard and turnip are also not unfrequently employed. In Scotland the turnip tops are never removed in the best-farmed districts, their manurial value being reckoned equal to that of 3 cwt. of Peruvian guano to the acre; and we have several times seen the second crop of clover ploughed down have the most wonderful effect on the succeeding crop of wheat or oats. Indeed, it is well known among farmers that a better crop of oats will be got immediately after a crop of clover, even when cut twice, than if it were allowed to lie another year for pasture, and no foreign substance be applied to it, or eaten on by sheep. This arises from the mass of vegetable matter which is left by the roots of the clover as food for the oat crop. Yea, in some fields we have seen it where it was more for the benefit of the tenant and the farm, in these days of light manures, to cut the hay and turn it up at once, than pasture it for two years. We think that there is no part of our Scottish leases that requires more revision than those clauses relating to hay and pasture.

We have only as yet spoken of those plants used as green-manure for the soil on which they grew; but the practice can be profitably carried out, particularly in Scotland, by transporting vegetables from where they grew to special fields. Of this kind the most important is manuring with sea-weed, the advantages of which are so well known as not to require us to dwell longer upon them here. A source of annoyance to most farmers is the growth of many weeds on waste ground, the sides of ditches, and of roads not much frequented, and the bottoms of fences. These, instead of being an eyesore and a nursery for weeds in the fields, as they are in too many cases, might be turned to profitable account, by cutting them down and gathering them into a heap, where a compost can be formed with them and any other waste matter on the farm, or a little dung; and from the mass of green vegetable matter collected, fermentation is soon produced, and the heap will be ready for putting on the stubbles immediately after the removal of the crop. And all this will be done at a time when the servants on the farm have comparatively little else to do.

A question of vital importance to the practical man requires to be answered here—Whether is it more profitable for him to consume these plants with animals, or use them as green manure?

There is no doubt, we think, that there is more returned to the soil by ploughing in the green plants than by consuming them with animals, and selling off the beef, mutton, milk, or whatever else may be produced. Numerous experiments detailed in both English and foreign works on agriculture prove this; and in a recent number of the *Journal d'Agriculture Pratique*, in an article written by M. Risler, we observe the following experiments showing the advantage of green-manuring over fallow, and also the consumption of the plants by animals:—"In the neighbourhood of Frankfort-on-the-Main, a farmer who had lost all his cattle by inflammation of the lungs, and did not wish to replace his stock immediately, ploughed down all his vetches and clover; the wheat which succeeded the green manure was much better than that beside it, which had been preceded by a fallow manured.

"Two English farmers, Messrs Love and Hawkins, estimated the crop of oats which they obtained after turnips that were ploughed in, the one at one-seventh more, the other at about 24s. per acre more than that which they got after turnips in the same field consumed by sheep.

"M. Schubart, in Mecklenburg, made the following experiments on plots of 65 square metres (about 78 square yards). These plots were manured after Christmas 1853 as follows:—

	Wheat. kils.	Straw. kils.
1st Plot, with the dung produced by a bull and calf in four days, during which they consumed in food and litter 30 kilogrammes of oat straw, 22 kilogrammes of barley straw, 44 kilogrammes of hay, 15 kilogrammes of wheat straw, and 15 kilogrammes of rye straw; in all, equal to 126 kilogrammes. The produce of the plot was	19.05	52.05
2d, With the same substances, without being consumed by the animals, 126 kilogrammes, . .	20.35	54.25
3d, With 126 kilogrammes of rye straw ploughed in,	18.40	53.45
4th, With 126 kilogrammes of wheat straw ploughed in,	21.75	57.75
5th, With 126 kilogrammes of rye straw, after being allowed to lie on the surface of the plot till the end of May, ...	20.50	50.00
6th, with 126 kilogrammes of wheat straw, treated in the same manner, ...	23.50	48.00

A kilogramme is equal to 2 lb. 3 oz. 4 drachms avoirdupois. These experiments fully prove that the soil will produce a larger crop from having the plants grown upon it ploughed in, than if they were consumed by animals and their manure applied to it. But still the question as to which practice is more profitable to the farmer is not yet answered, for the increased value of the stock consuming the food must be taken into account. This question will be answered by every farmer according to the situation of his farm, the nature of the soil, the system practised on it, and the

skill of the farmer in the management and the buying and selling of stock. Green-manuring, we conceive, will be found to be of more advantage in England and on the Continent, where vegetation is more rapid than in Scotland; and from the great heat, there is a necessity of having the soil well covered during the summer. More benefit is often derived from having the soil covered than is generally imagined. The soil may be regarded as a vast laboratory in which chemical action is unceasingly going on, now in decomposition, then in the formation of new compounds. Two of the most important results of this action are carbonic acid and ammonia, which, exposed to the air and heat, particularly in a loose soil, are soon carried off, if there is nothing in the soil to fix the ammonia. On this subject M. Risler has the following remarks:—"Another advantage which green-manuring has over fallow, consists in the physical action of the plants on the soil. During vegetation they retain—and the thicker they are the more effectually they do it—the moisture in the earth, and on the surface the carbonic acid which is disengaged. A paper, in the *Agricultural Journal*, of Dr Hamm, published some years ago, brings out this protective influence of green-manuring. Of two pieces of land of similar description, and of equal size, which had been similarly cultivated for some years previously, the one was sown with lupins, and the other was fallowed. When the lupins were in flower, they were cut, carried to the fallow, and ploughed in; then rye was sown on the two pieces. The part that was fallowed gave a less produce than the other.

"Cuthbert Johnston states a fact corroborative of this influence. An English farmer inadvertently left for some months a door in his fallow field; for several years after, the crops were particularly luxuriant where the door had been lying, so much so that one would have said that some rich manure had been applied to that spot." Every practical man is aware that the better a field in pasture is covered, the larger will be the crop when it is turned up. Now, this arises not merely from the pasture itself being better, and thus keeping more stock, but from none of the products of the chemical action in the soil being allowed to escape. Pasturing is just a kind of green-manuring. From the decay of the roots of the grasses and their blades when ploughed down, a mass of vegetable matter is collected, ready to minister to the growth of the succeeding crop; and during its decomposition, the organic elements are prevented from escaping, during the warm months of summer, by a thick covering of grass. A good farmer, then, who is also a skilful grazier, always studies to let his grass well up before stocking it full, as he knows that, by so doing, it will both keep more stock now, and give him a larger crop afterwards.

Green-manuring will be found more beneficial on light soils than

on clayey ones, for the reasons given above. One of the greatest advocates for the system is Mr Hannam, of Kirk Deighton, Yorkshire. He writes, in Morton's *Cyclopedia of Agriculture:* "In a strong clay, warmth and porosity are given; and upon a light and friable soil, where the furrow is properly pressed, tenacity and firmness are imparted by the fibrous roots. Without a previous crop of this kind, many lands are much too light to grow wheat. Upon the writer's own farm are many fields of magnesian limestone, that will not grow a good crop of wheat in any other course than after seeds or clover. However highly a fallow or stubble may be manured, it will not produce a field of wheat equal to that grown after seeds or clover."

Notwithstanding, we do not think that green-manuring can be recommended as a profitable practice in Scotland; for the crops which are usually cultivated for it are those which are much valued as green food at particular times during the summer. For instance, the vetch and the aftermath are both valuable to the farmer, from being ready to cut for his horses and cattle when his pastures have begun to fail; and the rape comes in as most nutritious food for sheep when the grasses have become hard in dry warm weather, besides the advantage which it possesses to the low country breeder of sheep, in exciting in the ewes a desire for the ram much sooner than would otherwise have been the case. There are some cases, however, where it may be thought advisable to resort to green-manuring even in Scotland, as in light sandy soils deficient of organic matter, and situated in a locality where that could not be readily applied to it. In such a case this object will be accomplished more easily and cheaply by growing some of the crops recommended for this purpose, and then ploughing them in at the proper time.

The Garden and Field Bean. By Mr Towers, of Croydon.—These plants, however they may differ in their several varieties, are of one family; that is, they belong to *Leguminosæ,* and to the tribe *Vicia* or vetch, which includes *Pisum*, the pea; *Ervum*, the tare; and some other genera. Having met with an article some time since, which I perused with considerable satisfaction, as it appeared to take a philosophical view of the plant and its habits and requirements, it occurred to me that, by presenting the substance of the paper to the readers of this Journal, I might convey some trustworthy and profitable information, whereby also much perplexity and disappointment might be obviated. We are instructed by Mr Stephens, and learn, that "beans are raised most in accordance with their nature, and with most profit, on clay soils suited to the culture of wheat; and in these soils they may be raised without manure, provided they follow a manured or single

cereal crop." It is also true, as experience in a variety of situations has shown, that the true garden-bean may be well grown in the common loam of English gardens, and even on much lighter soils, provided the one indispensable condition of early sowing (from mid January to the 15th of February) be rigidly observed; for if otherwise, the plant will rarely escape the ravages of the black aphis (or *dolphin*). One writer (to me unknown) introduces his subject with the question, " Is the *bean* a fertilising or an impoverishing crop? It is commonly received among farmers that it is not an *exhausting*, but rather an ameliorating crop, and that it prepares a soil better almost than any other for wheat. Yet chemists show us that it absolutely takes from the soil more nitrogenous matter than any other plant of a similar kind. Thus a produce of 30 bushels of beans per acre will remove, say 490 lb. of nitrogen—that is, of flesh-forming substances; while the same quantity of wheat will remove only 260 lb.; of barley, 40 bushels, only 280 lb.; of oats, the same yield will take away only 275 lb. Though there can be but little doubt that bean-straw is highly nitrogenous, yet pea-straw—a material of the same class—shows about eight times as much nitrogenous matter as the straw of wheat per acre, ten times as much as oats, and about fifteen times as that crop of barley. Hence the bean is a deazotising crop, both in the grain and in the straw, taken per acre—which is the most certain mode of calculating such articles of produce. Theory immediately says, 'Chemistry, therefore, has decided the *bean* to be an exhausting crop; and the reason why farmers so advocate it, is just the same as induces them to advocate the growth of any corn crop which they *know* deteriorates the soil in its permanent effects, but puts money in their pockets.' But we are not prepared to subscribe even to this, plausible as it may seem. What we mean to say practically is this, that, when properly cultivated, the bean is not an impoverishing crop, but the reverse. A very few physiological and practical facts will easily set us right on this point, and obviate the great objection some landowners have to seeing beans cultivated even on soils where *the clover* is worn out, and where the bean is used, and most successfully, as a substitute for that plant. The bean has a large leaf" (or rather *system* of leaves); " hence it derives a large proportion of its elements from the atmosphere. Treating leaves as the lungs of the plant, and knowing that the turnip, clover, and others, derive a proportion of their nourishment from the *atmosphere*, almost in the ratio of a large and small development, we easily see how the clover, when all mown off, is not much of an exhauster; while the wheat or the oat, having a small and feeble leaf-system, will take most from *the soil*. Nor are we altogether to forget the benefit of the shelter of the bean-leaves, the moisture, or the ammonia, that may fall on

the soil. In many cases a hot sun may evaporate the one and dissipate the other: the beans will, on the contrary, shelter the soil till both are absorbed, and these leaves fall off at harvest, by frosts or from ripeness, and thus assist by increasing the carbonaceous matter of the soil, and so at least fitting it for some kinds of crops.

"The bean is a deep tap-rooted feeder. Corn of all kinds permeates the surface-soil with fine, small, spreading filaments of roots. Deeper it might go if the soil were deeper worked and pulverised, but in ordinary cases it is a shallow, spreading root-feeder. The bean is the reverse; its deep-feeding root strikes directly down, and it is only at the lower parts of the root that the spongilæ are sent out. It derives its food, in fact, from a different part of the soil, so far as the root is concerned; and, therefore, it may be said to have a mode of supply altogether different from the corn crop which usually follows it. If the bean be a deep feeder, it must be assisted to get food where the root really goes; hence all good farmers *ridge their beans*, and in the ridges put some fertilising matter. All manures covered by the soil have a natural tendency downwards; and hence the bean-root will follow the manure deposited in the furrow. As the leaves are a great means of supplying the plant with food, they must have plenty of room to expand. Beans must be sown in wide ridges. We have seen *good*—perhaps the best beans—at 30 inches; excellent at 32 inches; but they ought never to be at less than 27 inches; and if properly cultivated, they will meet at those widths before harvest. The soil between must not be neglected, otherwise it will grow weeds, which will not only impoverish the soil, unfitting it for a future crop, but injure the progress of the beans themselves. Hence the horse and hand hoe must be liberally employed; or, what is better, the grubber; or even the plough itself may be used with advantage. Here there is both a crop and a fallow in the same year. The surface-soil is being cleansed and pulverised, while the subsoil is enriched, and growing a crop. Hence, the bean crop, when properly managed, derives its nourishment from the subsoil, while the surface-soil is pulverised, sheltered, and improved for the wheat crop."

I have given this article pretty nearly entire, not as being desirous to avail myself of the labour of another, but to convey some really valuable information. Admitting his general correctness, I regret the writer's assertion, that "*corn* of all kinds permeates the *surface soil* with fine, small, spreading filaments of roots." Now, in reference to *autumn-sown wheat*, I was enabled, by an experiment made by dibbling two rows of wheat, in 1843, at regular distances, to ascertain the mode of rooting that the seeds of wheat evince, according to the depth at which they are deposited. Much light is thrown upon this interesting fact by the perusal of the paragraphs 355 and 356, vol. ii., p. 324, of Mr Stephens' *Book of*

the Farm, 2d edition. The figures 293 and 294 adjoining exhibit the double *system of roots*, the one, and the deeper, called the *seminal*, and the upper or *coronal* root of the wheat. In fig. 294 is shown the form which the roots assume when sown in the spring near the surface. With deep sowing at *five or six* inches, the seminal roots penetrate to a great depth—to the extent, perhaps, of as many *feet*. "Wheat sown before winter should be so deeply covered with earth as to be beyond the reach of injurious frost—say 4 or 5 inches. In the spring the coronal roots will send out from these established plants abundance of *tillers* or stools; whereas the wheat sown in the spring should be lightly covered with earth, little exceeding 1 inch; and the tillers will be few."—*Idem*, p. 324.

I venture now to advert to another agricultural article on the bean, which we find in *The Royal Agricultural Journal*, vol. xiv., part 2, p. 423. Its title is, "On the *Bean-Turnip* Fallow. By the Rev. Th. Burroughes." Winter beans are sown "in two rows, 7 inches apart, and then a yard interval, in the middle of which is a single row of turnips; the average produce of the former, during five years, has been a little over 3 quarters per acre; the latter has been invariably a full half-crop, with both bulbs and leaves of a large size."

I trespass no further; but must in justice observe, that the entire six pages which the article comprises merit careful perusal and attention.

Everything that I have observed tends to impress my mind with the soundness of that theory advocated by the late De Candolle of *radical exudation*, which he supposed bore strongly upon the law that governs the *rotation of crops*. The experiment of Macaire tended to prove that matters were exuded by the roots of many plants; and recently I myself offered some evidences of the fact, in the two papers communicated through this Journal upon the *clover question*. How far the theory may bear upon the practice of *bean-turnip culture*, I am unable to decide, but feel authorised to state that, within a mile and a half from my residence, I witnessed bean and turnip culture, in alternate rows, on a gentleman's estate; both plants appearing to be strong and healthy. The manager, however, left this country two years since, and I received no information of the final results.

In closing this paper, I beg earnestly to request the strictest investigation of the great facts which bear upon the theory of rotation, as connected with exudation by the roots of plants. Assuredly the intellectual farmer would reap and enjoy profit with pleasure from his researches.

FIARS PRICES of the different COUNTIES of SCOTLAND, for Crop and Year 1854, by the Imperial Measure.

ABERDEEN.

	Imp. qr.
Wheat	63/7
Barley, without fodder	31/10
—— with fodder	36/10
Bere, First, without fod.	31/6
—— with fodder	36/6
—— Second, without fod.	30/
—— with fodder	35/
Oats, Potato, without fod.	26/4
—— with fodder	32/4
— Common, without fod.	25/4
—— with fodder	31/4
Pease	37/4
Beans	41/10
Malt, duty included	63/2
Oatmeal, per 140 lb.	19/1

ARGYLL.

Wheat	66/
Barley	32/8
Bere	30/8
Oats	27/8
Beans	47/
Oatmeal, per 140 lb.	19/10½

AYR.

Wheat	64/5½
Barley	32/9¾
Bere	30/10½
Oats	22/8
Pease	50/
Beans	49/7
Oatmeal, per 140 lb.	19/11½

BANFF.

Wheat	68/3
Barley, without fodder	30/4
—— with fodder	34/4
Bere, without fodder,	27/5
—— with fodder	31/5
Oats, Potato, without fod.	27/4
—— with fodder	32/4
— Common, without fod.	25/11
—— with fodder	30/11
Pease	37/9
Beans	37/9
Rye	
Oatmeal, per 140 lb.	18/10

BERWICK.

Wheat	66/10$\frac{7}{12}$
Barley, Merse	31/6$\frac{3}{12}$
—— Lammermuir	31/9$\frac{3}{12}$
Oats, Merse	29/1$\frac{3}{12}$
—— Lammermuir	26/11$\frac{11}{12}$
Pease	47/3$\frac{8}{12}$
Oatmeal, per 140 lb.	22/6$\frac{10}{12}$

BUTE.

	Imp. qr.
Wheat	61/9
Barley	33/2
Bere	29/
Oats	26/3¾
Pease and Beans	50/
Oatmeal, per 140 lb.	19/8½

CAITHNESS.

Barley	28/3¾
Bere	25/10½
Oats, Angus	24/
—— Sandy	24/
Oatmeal, per 140 lb.	19/8½

CLACKMANNAN.

Wheat	65/4½
Barley, Kerse	35/1¾
—— Dryfield	34/2¾
Oats, Kerse	27/2
—— Dryfield	28/1¾
Pease and Beans	44/8¾
Malt, duty included	70/0¾
Oatmeal, per 140 lb.	21/1½

DUMBARTON.

Wheat	63/5¾
Barley	32/2¾
Bere	30/2¾
Oats	26/9¾
Pease and Beans	46/6½
Oatmeal, per 140 lb.	21/4

DUMFRIES.

Wheat	67/2
Barley	33/8
Bere	
Oats, Potato	27/6
—— Common	25/4
Rye	47/6
Pease	
Beans	50/8
Malt	80/
Oatmeal, per 140 lb.	20/2½

EDINBURGH.

Wheat, First	68/1
—— Second	66/
Barley, First	35/1
—— Second	32/
—— Third	30/
Oats, First	29/6
—— Second	28/
Pease and Beans	46/6
Oatmeal, per 112 lb.	16/6
—— 280 lb.	41/3

ELGIN AND MORAY.

	Imp. qr.
Wheat	67/6
Barley	32/6
Oats	27/4
Pease and Beans	
Rye	35/9
Oatmeal, per 112 lb.	17/
—— 140 lb.	21/3

FIFE.

Wheat, White	67/2$\frac{2}{12}$
—— Red	64/10$\frac{1}{12}$
Barley	32/11$\frac{3}{12}$
Bere	30/8
Oats	27/8$\frac{2}{12}$
Rye	34/8$\frac{2}{12}$
Pease and Beans	42/7$\frac{4}{12}$
Malt	67/11$\frac{3}{12}$
Oatmeal, per 112 lb.	16/9$\frac{2}{12}$

FORFAR.

Wheat, without fodder	68/9
—— with fodder	
Barley	32/3
Bere	31/4
Oats, Potato	27/8
—— Common	27/4
Rye	33/6
Pease and Beans	41/3
Oatmeal, per 140 lb.	19/9

HADDINGTON.

Wheat, First	77/2½
—— Second	72/11¾
—— Third	67/6½
Barley, First	37/5¾
—— Second	35/8¾
—— Third	33/7½
Oats, First	32/11½
—— Second	30/11¾
—— Third	29/1¾
Pease and Beans, First	
—— Second	
—— Third	

INVERNESS.

Wheat, without fodder	67/
—— with fodder	72/
Barley, without fodder	30/6
—— with fodder	34/6
Bere, without fodder	
—— with fodder	
Oats, without fodder	28/1
—— with fodder	33/7
Rye, without fodder,	46/6
—— with fodder,	50/6
Pease, without fodder	46/6
—— with fodder	51/6
Oatmeal, per 112 lb.	16/10½

FIARS PRICES—*Continued.*

KINCARDINE.

	Imp. qr.
Wheat, without fodder	71/0½
—— with fodder	78/0½
Barley, without fodder	32/1½
—— with fodder	37/7½
Bere, without fodder	31/4¼
—— with fodder	36/10¼
Oats, Potato, without fod.	28/
—— with fodder	34/6
—— Common, without fod.	26/7½
—— with fod.	33/1½
Pease, without fodder	35/
—— with fodder	42/
Beans, without fodder	41/7
—— with fodder	48/7
Oatmeal, per 140 lb.	19/6½

KINROSS.

Wheat	59/9
Barley, First	31/10
—— Second	30/3
Bere,	
Oats, First	27/
—— Second	25/3
Pease	41/
Oatmeal, per 280 lb.	40/9½

KIRKCUDBRIGHT.

Wheat	68/6
Barley	33/2
Oats, Potato	
—— Common	27/0
Beans	49/2
Oatmeal, per 140 lb.	19/9½

LANARK.

Wheat, First	66/0 $\frac{8}{12}$
—— Second	64/2 $\frac{4}{12}$
Barley, First	34/2 $\frac{4}{12}$
—— Second	29/4 $\frac{8}{12}$
Bere, First	29/6 $\frac{9}{12}$
—— Second	
Oats, First	28/1 $\frac{8}{12}$
—— Second	24/3 $\frac{1}{12}$
—— Third	
Pease, First	45/4 $\frac{6}{12}$
—— Second	
Beans, First	48/3
—— Second	
Malt	68/10 $\frac{6}{12}$
Oatmeal, First, per 140 lb.	20/10 $\frac{4}{12}$
—— Second, do.	

LINLITHGOW.

Wheat	68/2
Barley	35/4
Oats	28/6
Pease and Beans	46/3
Malt	67/4
Oatmeal, per 112 lb.	16/8¼
—— 140 lb.	20/9

NAIRN.

	Imp. qr.
Wheat	66/6
Barley, without fodder	31/
—— with fodder	36/
Oats, without fodder	27/
—— with fodder	33/6
Oatmeal, per 112 lb.	17/4

ORKNEY.

Bere, per 376 lb.	21/4
Malt, per 140 lb.	12/5
—— with duty	24/3
Oatmeal, per 140 lb.	15/2

PEEBLES.

Wheat, First	67/8¼
—— Second	61/4¾
—— Third	53/3¼
Barley, First	33/8¾
—— Second	32/0½
—— Third	30/9¾
Oats, First	27/9
—— Second	26/2
—— Third	24/3
Pease and Beans, First	48/7
—— Second	47/11¼
—— Third	38/9
Oatmeal, per 140 lb. First	21/0¾
—— Second	20/3½
—— Third	19/3

PERTH.

Wheat, First	67/10
—— Second	60/6
Barley, First	32/10¼
—— Second	28/6½
Oats, First	27/6½
—— Second	26/2
Rye	34/10¼
Pease and Beans	41/5
Oatmeal, per 140 lb.	21/1

RENFREW.

Wheat, First	64/10¾
—— Second	63/5¼
Barley, First	30/8¼
—— Second	29/9½
Bere, First	30/8
—— Second	30/8
Oats, First	27/10¾
—— Second	27/1¾
Beans, First	49/0¾
—— Second	49/0¾
Oatmeal, per 140 lb. First	21/1¼
—— Second	21/0½

ROSS AND CROMARTY.

	Imp. qr.
Wheat, First	67/8
—— Second	67/2
Barley	31/10½
Bere	31/2
Oats, First	28/3
—— Second	
Pease	40/8
Beans	41/3¼
Malt	64/10½
Oatmeal, per 140 lb.	22/5½

ROXBURGH.

Wheat	68/8 $\frac{8}{12}$
Barley	32/5 $\frac{6}{12}$
Oats	28/1 $\frac{8}{12}$
Rye	
Pease	48/1 $\frac{4}{12}$
Beans	45/11 $\frac{1}{12}$
Oatmeal, per 140 lb.	21/2 $\frac{2}{12}$

SELKIRK.

Wheat	69/
Barley	32/5
Oats, Potato	26/8
—— Common	26/11
Pease	46/1
Oatmeal, per 280 lb.	40/6

STIRLING.

Wheat	60/2
Barley, Kerse	34/
—— Dryfield	33/6
Oats, Kerse	27/10½
—— Dryfield	27/5
—— Muirland	20/8
Beans	44/7½
Malt	67/4
Oatmeal, per 140 lb.	20/2¼

SUTHERLAND.

Wheat	66/
Barley	32/6
Bere	26/6
Oats	28/9
Pease	33/8
Rye	36/8
Oatmeal, per 140 lb.	22/4

WIGTOWN.

Wheat	63/2
Barley	32/2
Bere	27/8
Oats, Potato	24/10
—— Common	
Rye	44/
Pease	
Beans	43/8
Malt	87/8
Oatmeal, per 280 lb.	39/3

WE may inform our English readers, that Fiars Prices are the average prices of grain, as ascertained every year, by the verdict of Juries, in every County of Scotland. The Juries are summoned in spring, and ascertain, from the evidence produced to them, the average prices of the preceding crop. By these prices, rents payable in grain, and similar contracts, are generally determined; but the main object is to convert into money the stipends (for the most part fixed at a certain quantity of grain) of the Scottish Clergy.

AVERAGE PRICE OF THE DIFFERENT KINDS OF GRAIN,

PER IMPERIAL QUARTER, SOLD AT THE FOLLOWING PLACES.

LONDON.

Date.	Wheat.		Barley.		Oats.		Rye.		Pease.		Beans.	
1855.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 3.	74	6	32	9	20	11	40	0	42	7	43	3
10.	76	6	33	4	27	7	40	10	40	4	40	8
17.	71	9	32	9	28	9	40	6	43	7	44	0
24.	73	7	32	0	32	0	40	0	37	10	40	6
Mar. 3.	73	3	32	3	26	7	40	9	39	9	41	3
10.	72	9	31	6	25	5	41	1	42	6	41	2
17.	70	4	31	6	24	11	40	8	38	7	37	10
24.	70	1	31	0	26	3	40	0	36	7	36	7
31.	72	3	31	1	25	10	40	4	38	11	38	3
April 7.	72	9	32	0	25	4	40	6	38	6	37	6
14.	73	6	32	2	26	5	40	7	41	4	39	1
21.	73	0	32	1	26	1	40	0	35	1	38	5
28.	72	8	32	7	25	11	40	8	40	4	37	8
May 5.	73	4	32	0	26	10	41	3	40	3	37	4
12.	80	4	35	2	28	1	42	3	41	9	40	1
19.	79	6	32	5	29	5	44	0	44	11	40	5
26.	81	7	33	9	28	6	44	1	40	11	42	3

EDINBURGH.

Date.	Wheat.		Barley.		Oats.		Pease.		Beans.	
1855.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 7.	69	10	33	9	28	1	44	6	45	5
14.	69	11	33	0	28	8	44	9	45	11
21.	68	0	32	7	28	9	44	2	44	10
28.	69	3	33	5	29	4	45	4	46	0
Mar 7.	68	1	32	7	30	4	45	10	46	11
14.	70	8	32	10	30	3	45	3	45	11
21.	70	4	33	11	31	0	44	10	45	6
28.	70	5	35	2	30	10	45	2	45	10
April 4.	72	7	36	3	31	9	45	6	46	0
11.	72	2	35	11	31	6	45	0	45	8
18.	72	6	35	1	30	2	45	3	45	10
25.	72	3	35	2	29	10	45	4	46	3
May 2.	76	11	36	3	32	1	46	6	47	5
9.	75	9	36	0	32	8	47	1	47	9
16.	75	7	36	4	32	1	47	0	47	8
23.	76	3	36	9	32	8	47	8	48	7
30.	77	10	37	11	34	3	49	2	49	11

LIVERPOOL.

Date.	Wheat.		Barley.		Oats.		Rye.		Pease.		Beans.	
1855.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 3.	72	10	29	11	27	7	42	8	42	7	44	4
10.	71	6	29	11	27	5	42	2	40	4	42	5
17.	70	6	30	7	26	10	41	6	37	11	43	9
24.	70	8	31	2	25	8	42	0	45	0	47	8
Mar. 3.	69	6	31	9	26	7	39	8	39	0	41	9
10.	69	10	29	5	27	5	40	4	38	6	44	1
17.	66	10	29	2	26	2	40	6	37	5	41	6
24.	69	3	30	0	27	5	40	1	39	4	42	10
31.	69	0	30	3	26	9	39	3	43	9	45	5
April 7.	68	10	27	6	23	8	38	8	37	0	41	8
14.	69	2	29	8	27	4	39	4	37	5	43	10
21.	68	10	29	6	27	2	38	2	37	7	43	9
28.	68	11	30	4	25	5	40	3	39	8	44	10
May 5.	71	2	31	2	23	10	41	4	39	7	44	0
12.	72	2	33	8	26	4	42	9	40	1	48	3
19.	75	7	30	9	26	10	41	7	40	8	46	2
26.	77	5	35	4	29	0	41	2	41	2	47	10

DUBLIN.

Date.	Wheat, p. barl. 20 st.		Barley, p. barl. 16 st.		Bere, p. barl. 17 st.		Oats, p. barl. 14 st.		Flour, p. barl. 9 st.	
1855.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 2.	41	6	19	9	15	6	15	3	24	8
9.	40	8	19	6	15	4	15	0	24	6
16.	40	5	18	9	15	6	15	0	24	7
23.	40	10	18	10	15	3	15	2	24	10
Mar. 2.	40	8	18	6	15	1	15	0	24	9
9.	40	4	18	2	15	4	14	8	24	6
16.	39	9	18	0	15	2	13	10	24	4
23.	40	11	18	11	14	9	14	4	24	2
30.	40	0	17	8	15	1	14	2	24	2
April 6.	40	3	17	10	14	10	14	0	24	3
13.	40	8	18	2	15	6	14	11	24	5
20.	40	9	17	9	15	0	14	10	24	3
27.	41	6	20	0	16	2	16	3	24	6
May 4.	45	2	18	6	16	0	15	2	25	6
11.	45	10	19	7	16	8	16	1	25	9
18.	45	9	18	7	16	4	15	9	25	8
25.	44	3	18	2	16	2	15	10	25	4

TABLE SHOWING THE WEEKLY AVERAGE PRICE OF GRAIN,

Made up in terms of 7th and 8th Geo. IV., c. 58, and 9th and 10th Vict., c. 22. On and after 1st February 1849, the Duty payable on FOREIGN CORN imported is 1s. per quarter, and on Flour or Meal 4½d. for every cwt.

Date.	Wheat.				Barley.				Oats.				Rye.				Pease.				Beans.			
	Weekly Average.		Aggregate Average.		Weekly Average.		Aggregate Average.		Weekly Average.		Aggregate Average.		Weekly Average.		Aggregate Average.		Weekly Average.		Aggregate Average.		Weekly Average.		Aggregate Average.	
1855.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 3.	70	11	72	5	32	2	33	5	26	7	27	2	42	9	45	4	43	0	43	9	44	2	45	10
10.	71	1	72	0	32	6	33	2	26	2	26	10	42	1	44	6	40	5	42	9	43	9	45	3
17.	70	3	71	4	31	9	32	9	25	7	26	6	45	3	44	0	41	0	42	0	43	1	44	7
24.	69	1	70	6	31	5	32	3	25	6	26	3	41	1	48	3	39	8	41	5	43	3	44	1
Mar. 3.	68	6	69	11	30	11	31	10	25	3	25	11	41	10	42	8	39	9	40	11	42	2	43	5
10.	68	0	69	8	30	6	31	6	25	2	25	8	38	7	41	11	39	4	40	6	40	8	42	10
17.	66	11	69	0	30	5	31	3	24	10	25	5	39	4	41	4	38	6	39	9	40	4	42	2
24.	66	6	68	2	29	9	30	9	25	0	25	3	39	1	40	10	38	9	39	6	40	0	41	7
31.	68	7	67	11	30	5	30	7	25	6	25	3	38	10	39	9	38	7	39	1	40	5	41	1
April 7.	68	5	67	10	30	8	30	5	24	11	25	1	42	2	39	11	37	9	38	9	40	8	40	8
14.	68	4	67	9	31	1	30	6	25	10	25	3	39	11	39	8	39	2	38	8	41	2	49	7
21.	68	8	67	11	31	5	30	8	25	10	25	4	38	11	39	8	36	10	38	3	41	5	40	8
28.	68	4	68	2	31	6	30	10	25	9	25	6	40	10	39	11	39	2	38	5	41	6	40	10
May 5.	69	5	68	7	31	3	31	1	26	0	25	8	38	0	39	9	38	7	38	5	41	7	41	2
12.	73	4	69	5	31	10	31	4	26	11	25	11	40	9	40	1	40	2	38	8	43	2	41	7
19.	76	1	70	8	32	5	31	7	27	9	26	4	44	3	40	5	42	4	39	5	44	5	42	3
26.	76	10	72	1	32	11	31	11	28	1	26	9	44	5	41	2	40	3	39	7	45	2	42	11

FOREIGN MARKETS.—Per Imperial Quarter, free on board.

Date.	Markets.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1855.		s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Feb. ..	Danzig	58 0 - 74 0	24 0 - 30 0	15 6 - 23 0	32 0 - 38 0	32 0 - 37 6	36 6 - 42 0
March	Danzig	56 0 - 68 0	22 6 - 28 0	16 0 - 22 6	33 6 - 39 6	34 0 - 40 6	37 6 - 43 0
April ..	Danzig	58 0 - 72 0	21 6 - 27 6	16 6 - 22 0	34 0 - 41 6	34 6 - 41 6	36 0 - 41 6
May ..	Danzig	68 0 - 76 0	23 0 - 29 6	17 6 - 23 9	32 6 - 39 6	32 0 - 40 0	35 6 - 40 0
Feb. ..	Hamburg	59 6 - 68 6	22 6 - 28 0	17 6 - 24 0	34 6 - 41 0	32 6 - 40 0	34 6 - 42 0
March	Hamburg	60 6 - 70 6	20 0 - 26 6	15 6 - 24 0	33 6 - 40 6	34 0 - 41 6	35 0 - 44 0
April ..	Hamburg	63 0 - 73 0	20 6 - 28 6	15 0 - 22 6	34 6 - 41 6	32 6 - 40 0	35 6 - 45 0
May ..	Hamburg	65 6 - 77 0	22 0 - 29 6	18 6 - 24 0	34 0 - 40 6	34 0 - 42 0	36 6 - 46 0
Feb. ..	Bremen	58 0 - 66 0	23 0 - 28 0	15 6 - 21 0	32 6 - 39 0	32 0 - 40 6	34 6 - 42 0
March	Bremen	56 0 - 63 0	24 0 - 30 0	16 6 - 23 0	31 6 - 38 0	30 6 - 37 6	33 6 - 40 6
April ..	Bremen	56 0 - 64 0	23 0 - 28 6	16 0 - 24 6	32 6 - 39 0	31 6 - 39 0	34 6 - 42 0
May ..	Bremen	61 6 - 73 6	25 6 - 32 0	15 6 - 23 6	33 6 - 41 0	33 6 - 40 6	35 0 - 42 6
Feb. ..	Königsberg	55 0 - 65 0	25 6 - 33 0	15 0 - 21 6	33 0 - 38 6	34 0 - 41 6	36 6 - 42 0
March	Königsberg	54 0 - 63 6	22 6 - 32 0	16 0 - 21 0	32 6 - 37 6	32 6 - 38 6	34 6 - 41 0
April ..	Königsberg	56 0 - 66 0	20 6 - 30 0	16 6 - 22 6	33 6 - 39 0	33 6 - 39 0	35 6 - 43 0
May ..	Königsberg	60 0 - 70 0	21 0 - 31 6	17 6 - 24 0	34 6 - 40 6	35 0 - 42 6	36 6 - 47 6

Freights from the Baltic, from 4s. 3d. to 7s.; from the Mediterranean, 7s. 6d. to 14s. 6d.; and by steamer from Hamburg, 4s. 6d. to 7s. per imperial qr.

THE REVENUE.—From 31st March 1854 to 31st March 1855.

	Quarters ending March 31		Increase.	Decrease.	Years ending March 31.		Increase.	Decrease.
	1854.	1855.			1854.	1855.		
	£	£	£	£	£	£	£	£
Customs	4,203,091	4,424,151	221,060	..	20,200,933	20,496,658	295,725	..
Excise	2,173,132	2,384,416	211,284	..	15,101,591	16,179,169	1,077,578	..
Stamps	1,622,827	1,677,771	54,944	..	6,789,835	6,965,516	176,131	..
Taxes	99,302	194,897	95,595	..	3,141,694	3,036,136	..	105,558
Post-Office ..	247,000	292,922	45,922	..	1,069,000	1,299,156	230,156	..
Miscellaneous	369,520	306,411	..	43,109	1,502,892	1,004,150	..	498,742
Property Tax	1,942,096	5,740,708	3,798,612	..	5,378,035	10,515,369	5,137,334	..
Total Income	10,636,968	15,021,276	4,427,417	43,109	53,183,980	59,496,154	6,916,924	604,300
	Deduct decrease....		43,109		Deduct decrease....		604,300	
	Increase on the qr...		4,384,308		Increase on the year		6,312,624	

PRICES OF BUTCHER-MEAT.—Per Stone of 14 Pounds.

Date.	LONDON. Beef.	LONDON. Mutton.	LIVERPOOL. Beef.	LIVERPOOL. Mutton.	NEWCASTLE. Beef.	NEWCASTLE. Mutton.	EDINBURGH. Beef.	EDINBURGH. Mutton.	GLASGOW. Beef.	GLASGOW. Mutton.
1855.	s. d. s. d.	s. d. s. d.	s. d. s, d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Feb. ..	6 3 - 8 6	6 6 - 8 9	6 6 - 8 3	6 6 - 8 6	6 0 - 8 6	6 3 - 8 0	6 3 - 7 9	6 6 - 7 9	6 0 - 7 9	6 3 - 8 0
March	6 3 - 8 9	6 6 - 8 9	6 9 - 8 3	7 6 - 9 6	6 3 - 8 6	6 3 - 8 6	6 6 - 8 0	6 6 - 7 9	6 3 - 7 9	6 6 - 8 3
April	6 3 - 8 6	6 6 - 8 9	6 9 - 8 6	7 6 - 9 6	6 3 - 8 9	6 6 - 8 9	6 6 - 8 3	6 9 - 8 3	6 6 - 8 0	6 9 - 8 6
May ..	6 6 - 8 9	6 9 - 9 6	6 9 - 8 9	7 9 - 9 6	6 0 - 8 6	6 0 - 8 6	6 6 - 8 6	6 9 - 8 6	6 6 - 8 6	6 9 - 8 9

PRICES OF ENGLISH AND SCOTCH WOOL.—Per Stone of 14 Pounds.

ENGLISH.	s. d. s. d.	SCOTCH.	s. d. s. d.
Merino, ...	13 6 to 22 0	Leicester Hogg, ...	14 6 to 16 6
.. in grease, ...	10 0 to 15 6	.. Ewe and Hogg, ...	10 0 to 14 0
South-Down, ...	14 0 to 17 6	Cheviot, white, ...	9 6 to 14 6
Half-Bred, ...	12 0 to 15 0	., laid, washed, ...	7 3 to 12 0
Leicester Hogg, ...	13 6 to 16 0	.. .. unwashed,........	6 3 to 9 9
.. Ewe and Hogg, ...	11 0 to 14 0	Moor, white, ...	5 0 to 7 6
Locks, ...	7 0 to 8 0	.. laid, washed,............	4 3 to 6 3
Moor, ...	5 3 to 6 9	.. .. unwashed,..........	4 0 to 5 8

Date.
1855.
Feb. ..
March
April ..
May ..
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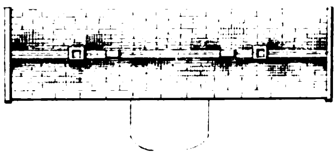

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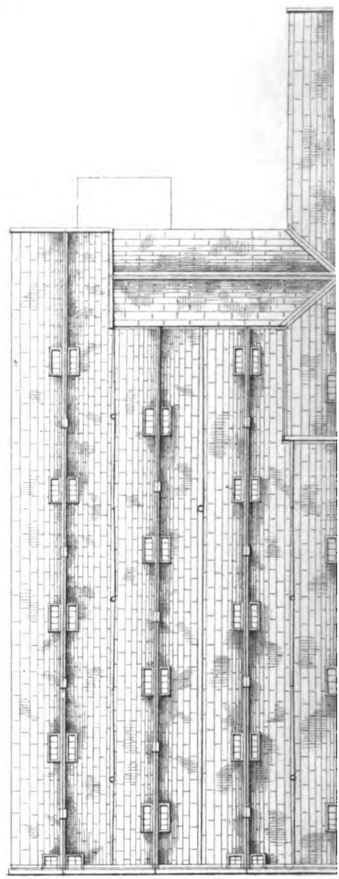

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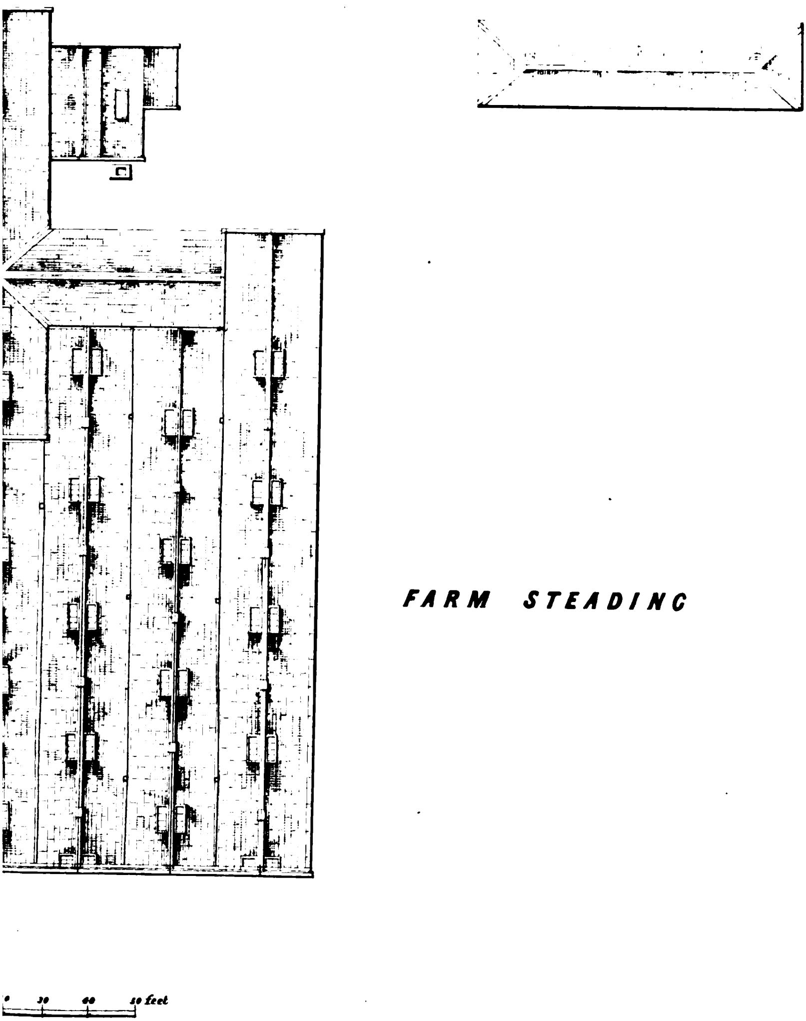
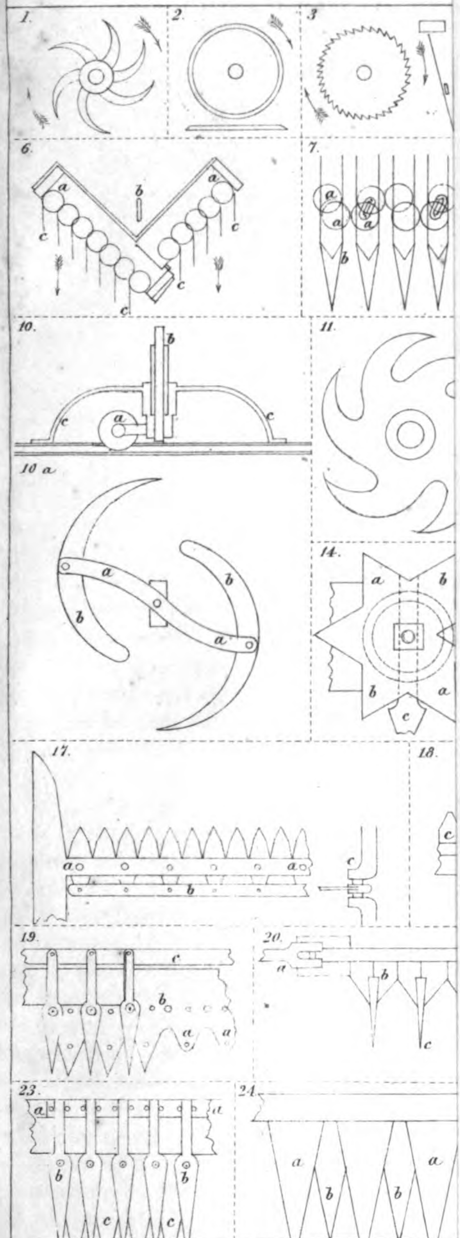


FARM STEADING

Schenck & McFarlane, Lith. Edinb.

Plate III.

TABU
of
Patent R



THEORY OF LIQUID-MANURING AND IRRIGATION.

By R. RUSSELL, Kilwhiss.

A NEW era in agricultural theory may be dated from the period that Liebig propounded his celebrated proposition, that the food of plants was entirely mineral or inorganic. The great success of applications of phosphates, nitrates, and salts of ammonia to our cultivated crops, is strong evidence for the truth of his deductions.

In his view, animal and vegetable substances only become the food of plants after they are entirely disorganised, or reduced to their mineral or inorganic form by putrefaction or decay. On this point a considerable difference of opinion still exists among chemists and vegetable physiologists, many able authorities maintaining that our cultivated plants are capable of assimilating organic compounds, and converting them into their own substance. We are quite aware that a number of facts seem to indicate that certain plants have the power of assimilating organic substances. A considerable number had occurred to our own mind, but we had entirely failed to discover any principle by which the two modes of nutrition were to be separated, until we had occasion lately to discuss this subject with Professor Henry, Washington, one of the most original minds of the day, who suggested that Liebig had overlooked an important principle in this question; and we think it is one that forms a necessary qualification to the mineral theory.

It cannot be doubted that, in the germination of seeds, the new organs are merely derived from the transformation of the substance of the seed. In this instance there is an absorption of oxygen and evolution of carbonic acid. Part of the organic substance of the seed is thus reduced to the inorganic state, and this appears to be as much a condition of germination as respiration is of vitality in the animal. From the absorption of oxygen results the force placed at the disposal of the vital principle which directs it towards the production of the new organs. This, it will be seen, closely resembles the functions connected with animal life and nutrition.

On the other hand, we believe it is universally admitted by chemists and physiologists, that a plant only possesses the power of decomposing carbonic acid under the influence of light. The rays of light, therefore, must not only be regarded as the power by which the leaf of a plant is enabled to decompose carbonic acid, but also the power placed at the disposal of the plant to maintain those forces which we regard as vital. Liebig has well said, that as respiration in the animal is as the falling weights which keep the clock in motion, so light answers the same end in the vegetable.

Carbonic acid, though the chief food of plants in ordinary circumstances, cannot be decomposed and appropriated when light is

absent, and thus the food of those plants which grow in the dark must necessarily be organic, because they have not the power of assimilating inorganic. Plants growing in the dark must be regarded as having functions parallel to those in animals; the absorption of oxygen, or decomposition of part of the food, being a primary condition of vegetation.

There are certain plants also of a low organisation, devoid of green colouring matter, the food of which, it is highly probable, from their peculiar habits, is also principally, if not altogether, organic. Fungi, as the German physiologist M. Mohl maintains,* may be considered as belonging to this order. Professor Way and others have attributed the growth of fungi, which form the fairy rings of our pastures, to the great powers which they possess of absorbing ammonia and carbonic acid from the atmosphere; but we rather think that the phenomenon is erroneously interpreted, and that the food of those fungi is principally organic.

Therefore the germination of seeds, the growth of plants in the dark, as well as of some of a low organisation, are all characterised by an absorption of oxygen, or decomposition of part of the food of the plant, which process is the active power of vegetation under these circumstances, and is a substitute for light in those cases in which the food of plants is organic.

There are other facts which are worthy of discussion connected with this highly interesting subject, where it is difficult to draw the line of distinction between the oxydating and deoxydating processes. At another time we may return to this question, and devote an article to its consideration. Our object at present is merely to qualify our assent to the mineral or inorganic theory of vegetable nutrition of Professor Liebig—a theory which we believe holds true with respect to all our cultivated crops; and if we bear it constantly in mind, it tends to simplify all the principles of manuring.

We are not aware of a single fact in agricultural practice which the remains of the old humus theory, which is now sometimes dressed up in new phraseology, are calculated to explain; but it would not be difficult to point out many errors in our modern agricultural writers which directly flow from seeking an explanation of facts from this source. We may instance the case of that distinguished physiologist, M. Mohl, who, in attempting to reduce the peculiar wants of plants to a system, has, in the same page already referred to, mixed up things that differ to a greater extent than any author we have seen. It appears somewhat strange that our own writers on physiology have, in their liberal commendations, overlooked many very questionable deductions in this valuable work.

* *Principles of the Anatomy and Physiology of the Vegetable Cell.* By Hugo von Mohl. Translated by A. Henfrey. London: J. Van Voorst. See p. 79.

The principles of manuring are made very simple, when we regard the food of all cultivated plants as made up of carbonic acid, water, and ammonia (or nitric acid), with the mineral matters found in their ashes. These plants are nearly composed of the same substances, but their habits of growth require very different modes of supplying them with food. The philosophy of liquid-manuring and irrigation can only be written by keeping the mineral theory and the physiological peculiarities of plants closely in view.

A considerable difference of opinion exists among practical and scientific men as to whether reservoirs are necessary for storing the liquid manure, to bring out the full benefits which may be derived from its application. This is a highly important question, and well deserving the consideration of those who have given this system of manuring a trial, or who intend to do so. We are far from thinking the opinions of the Commissioners of the General Board of Health on the point are borne out by experience.

The experiments made by the Rev. A. Huxtable and by Mr Way, and the scientific results already referred to as thence deduced, are in complete accordance with the results of practice, and leave no doubt that liquid manure may be applied to the land when it is fallow, with the certainty of the best incorporation, and that the deposit there will be safe and available for the subsequent crop. These experiments, corroborated by the results of practice of repeated applications during the growth of vegetation, prove that the application of liquid manure to land may, under proper management, with interruptions of hard frost only, be as continuous as its production. They dissipate the exaggerated estimates as to the extent of storage, and the great expense and inconvenience of the reservoirs required for such manure.—P. 25.

We have not seen a detailed account of Mr Huxtable's experiments; but so far as the Commissioners have supplied us, the evidence that liquid manure is entirely safe when applied in autumn, and available for the crops in summer, is exceedingly meagre indeed. It is almost needless to point out that, so far as we are left to gather from the following paragraph, both applications might or might not have been entirely washed out of the soil.

The Rev. Mr Huxtable has recently reported an experiment tried to test the durability of manure in the liquid form. He found that wheat manure, at the time of sowing with 10 hogsheads per acre (2¼ tons) of cow's urine, produced as good a crop as that manured at the time of sowing with guano in the proportion of 2 cwt. per acre. The result of this experiment shows that liquid manure lasts not only during winter, but even until the harvest time of wheat, the latest of our cereals, and is exactly correspondent with Mr Huxtable's former experiments, which proved the power possessed by soil of absorbing, and retaining for the sustenance of vegetation, manure contained in any liquid which filters through it, for it is evident that the liquid itself could not be retained for months in the soil.—P. 24.

We consider Professor Way's researches on the absorptive powers of soils as most important contributions to agricultural science. They give us especially some insight as to the curious relations of silica to the growth of vegetables; but we must confess that grave doubts arise when the absorptive properties of soils are so rigidly applied in practice as many have done, in recommending

liquid manure to be applied at all seasons of the year,—and that tanks are not necessary for preparing it, and retaining it until vegetables can make use of it.

Many objections can be urged against the extreme view as put forth by the Commissioners. Some are of the most simple character. If we assent to the common opinion entertained by chemists and physiologists, that plants merely take up those substances which are dissolved by the water which enters their roots, then it must be evident that the particular combinations of ammonia and other substances formed must possess a certain degree of solubility, otherwise they could not find their way into plants. The same degree of solubility which enables water to convey manure into plants, will also enable water to wash it out of the soil during heavy rains. To maintain the contrary, we would be forced to admit that, while the valuable elements were safe, yet the plants, Tantalus-like, might die amid abundance, seeing that their food was in so insoluble a state that it could not be absorbed. And thus, if we subscribe to the opinion that plants merely take up their food by the physical process of absorbing what substances are actually in solution, a plant grown on any soil, and carried off, must have exhausted the soil in direct proportion to the amount of water which entered its roots and was evaporated from its leaves. The amount of waste from drainage water must also be in proportion to the quantity of water which passes through the soil into the drains.

That a very considerable loss of fertilising matter occurs in our fallow and wheat fields during the autumn and winter rains, many facts which have been brought out in the actions of manure seem to show. Experience has demonstrated that a pound of nitrogen in nitrate of soda, applied to the wheat and grass crops in spring or early summer, is about as effective in increasing their yield as two pounds of nitrogen in the form of guano when applied in autumn. Mr Pusey has detailed the results of some interesting experiments on this subject; Mr Caird's valuable testimony also bears out this interesting fact: but the quantity of nitrate of soda used by farmers for wheat and grass crops may be considered as merely the summary of hundreds of experiments which declare the same results. We cannot believe that the wheat plant has the power of wasting nitrogen, as a functional process, to a much greater extent when this element enters as ammonia in guano than as nitric acid in nitrate of soda. The economy of nitrate of soda can scarcely be ascribed to any other principle than the simple one that it is applied when the crops are in need of it, and that it is the most available form for absorption by the roots. In the defects of our systems of manuring, rather than in any supposed habits that the wheat plant has for a great excess of nitrogen in its proper food, must we look for an explanation of the waste which actually occurs in practice.

Some, founding their opinions on Professor Way's experiments, have considered that there is no waste by washing when manure is applied to the stubbles in autumn. This we have always doubted, for those farmers in Fifeshire who have followed autumn manuring for many years as a matter of convenience, maintain that, while the green crops may often be as good as in the case where the dung is applied at seed-time, still the succeeding wheat is usually more deficient. A slight reaction is taking place in other districts on this subject. Mr Hope, Fentonbarns, in a communication to an Edinburgh paper in December last, writes: "Another change in practice may be noted, which is, that less manure has been carted to the stubbles than for some years past. Doubtless, when ploughed in with the winter-furrow, a great amount of labour is saved in spring, and the different crops are sown more quickly, often a matter of great consequence; still experience has proved that farmyard manure, in the majority of instances, is most efficacious on green crops when applied directly in drills."

Another interesting fact is brought out in Professor Way's valuable experiments; viz. that clay soils seem to retard the fermentation of certain animal matters.

Clay appears to have a remarkable action in reference to the fermentation of organic matters. It seems, indeed, to oppose fermentation, as will be seen in the following experiment :—

Three quantities of fresh urine, of 2000 grains each, were measured out into similar glasses. With one portion its own weight of white *sand* was mixed ; with another, its own weight of white *clay* ; the third being left without admixture of any kind.

When smelled immediately after mixture, the sand appeared to have had no effect, whilst the clay mixture had entirely lost the smell of urine ; they were all decidedly acid to test-paper. The three glasses were covered lightly with paper, and placed in a warm place, being examined from time to time. In a few hours it was found that the urine containing sand had become slightly putrid ; then followed the natural urine ; but the quantity by which clay had been mixed *did not become putrid at all*, and at the end of seven or eight weeks it had only the peculiar smell of fresh urine, without the smallest putridity. The surface of the clay, however, became afterwards covered with a luxuriant growth of confervæ, which did not happen in either of the other glasses.

This is a remarkable experiment, and one from which much instruction may be derived. The reason that the sand accelerates the fermentation of the urine is no doubt this : All bodies possess a surface attraction for gases, and of course, therefore, for common air. This attraction, which enables them to condense a certain quantity of air on their surfaces, is in direct relation to the extent of those surfaces. In mixing sand with the urine, we are in effect exposing the latter to a greatly increased surface of air, the oxygen of which is necessary to commence the putrefaction, and thus hastening the changes which soon or late would occur in urine naturally. But what shall we say of the action of the clay ? That it retards or changes the nature of the putrefaction is evident ; but the question is, does it prevent the conversion of the animal matters into the ordinary products of decay ; or does it allow of that conversion, and absorb those products as they are formed ? This is a most vital question to practical agriculture, clearly affecting our views of the state in which animal manures should be employed, and affecting also in the highest degree the theoretical notions of vegetable nutrition.—*Journal of the Royal Agricultural Society*, vol. xxv. p. 366.

This experiment, we conceive, affords an explanation of the practice so universally followed in all countries, of fermenting

urine before applying it to the fields or growing crops. The experience of agriculturists in Italy, Switzerland, France, Belgium, and at home, all seems to attest the necessity of fermentation. We have met with many who have practised liquid-manuring on a small scale, averring that the application of fresh urine to grass is attended with little or no effect. It is highly probable that plants either do not have the power of assimilating urea, or that the roots have comparatively little power in taking it up. We suspect the former must be assented to, if we subscribe to the doctrine that plants take up promiscuously those substances which are in solution, and support the inorganic theory of vegetable nutrition; or the latter supposition, which will be adverted to in the sequel.

To ferment urine before it is applied, may be considered as essential to the successful carrying out of any system of liquid-manuring. In fact, the fermentation of liquid manure on a large scale, such as at Myer Mill, is one of the prime difficulties which besets those who, trusting to their former experience, look upon this process as a *sine quâ non*. Large reservoirs, sunk into the ground where the temperature is low, are not favourable for the promotion of fermentation, especially when the liquid manure is diluted with water. So far as our memory serves us, we were informed, some years ago, while on a visit to the Ayrshire establishments, that rape-cake was thrown into the tanks in small quantities, to promote fermentation, and not, as many have imagined, for the purpose of supplying phosphates. Tank-water is no doubt a little deficient in phosphates, but there can be few farms where there is much surplus liquid that will not grow maximum crops of all kinds with fermented urine alone.

The Commissioners of the General Board of Health, in the "Minutes of Information," allude to a highly important subject in vegetable physiology, which it will be best to consider at this stage of the discussion.

It has been found that the miscellaneous nature of the town manures, instead of being unfavourable, is favourable to vegetable production. In the instances of irrigation with compounded or miscellaneous manure, as compared with the applications of simple or comparatively simple manures, the grass which had received the miscellaneous manure was by far the richest, and the cattle went first to the portion of the field so irrigated. These results are in accordance with the principles of vegetable physiology, for it is the faculty of the roots of plants not only to seek their food, but, when they have arrived at it, to *select* that which is most suitable to them, as Sir Humphry Davy long ago ascertained: they do not take up everything that is presented to them. This, which may be designated as the selective power of the roots of plants, appears to be a most important property for application to the absorption of town manures, which, consisting of the remains of everything taken into the town, are in the highest degree miscellaneous.

What is here called the selective power of the roots of plants, is not only an important principle in its application to town manures, but in a still greater degree to liquid manures produced on the farm. The subject has also important bearings in reference to the

irrigation of lands from rivers and springs as well as to general manuring.

It is somewhat curious that in the course of our reading we believe we have found Sir Humphry Davy as frequently quoted as having shown that plants absorb all those substances which are in solution promiscuously, as we have found him quoted that plants only absorb such substances as they can assimilate. The reporter, in this instance, has evidently got his information second-hand, for it happens that Sir Humphry Davy's opinions were against the idea that plants had the power of selection. In his fifth lecture on Agricultural Chemistry this subject is discussed, but only in such a manner that it is very far from being satisfactory either for the one view or for the other.

The experiments carried out by Saussure are very interesting, if the results can be relied on. He found that plants with healthy roots do take up substances in very different quantities from solutions of the same degree of concentration. The roots apparently acted as a filter to some, while others passed into the plants in the same proportions nearly as they were contained in the water. But the poisonous sulphate of copper entered more freely than any of the others, some of which are known to be powerful manures. Saussure tried to explain these differences by supposing that the greater quantity of any substance absorbed was owing to the greater or less viscidity which it imparted to the water. The experiments of Trinchinetti were attended with different results from those of Saussure; they seemed to indicate that the roots of plants absorbed one substance in preference to another, while the degree of viscidity of the solutions could not account for the facts.

It is somewhat difficult to devise experiments to decide this question, because we often have to place plants in conditions that interfere with the healthy functions of their roots. Putting experiments aside, which are by no means of a satisfactory character, we are inclined to contend for a function in the roots of plants, which has a close resemblance to a faculty of selection of certain substances that are specially adapted for building up the vegetable structure, on the simple consideration that such a faculty is necessary for explaining many of the facts of agriculture. This faculty, we are inclined to think, follows as a corollary from the demonstrations of experience.

If Saussure is right in his idea that plants have the power of preventing certain substances from penetrating the spongioles, this would be an important point. We think, however, it is more probable that the roots of plants do not have any great powers in this respect, but that they have a great extra power of absorbing such substances as are fitted for assimilation.

The selective power of the roots is a term which conveys a very

imperfect idea of the nature of this action, because in all probability it is a chemical, and not so much a vital action, as this term would almost imply. The correct view of the matter is to consider that the roots of plants exercise a similar action upon substances in solution that come in contact with them, as the leaves do upon the carbonic acid or ammonia of the atmosphere.

Leaves cannot be said to select the carbonic acid and ammonia of the atmosphere, but they absorb these inorganic compounds by virtue of certain affinities which exist between them under the influence of light. The membrane which separates the cell-contents in the spongioles of the roots of plants from the inorganic world, is of a very delicate character, and we can have no greater difficulty in comprehending how it can absorb those inorganic substances, which may have special affinities towards organic matters in the cell-membrane or cell-contents, than that certain organic matters in the leaf attract and absorb carbonic acid under the influence of light. Many physiologists are also inclined to regard the absorption of oxygen by plants as a chemical process directed by vitality.

Special absorption, therefore, is perhaps the better term for such a function of the roots of plants. The action of poisonous substances, such as sulphate of copper, instead of being in contradiction to this view, is entirely in accordance with it. Liebig has shown that many poisons act by forming compounds with organic matter, which are incapable of undergoing chemical changes—the necessary condition of vitality. Small quantities of acid vapours floating in the air are absorbed by the leaves of plants as freely as those elements which are their proper food. Special absorption must take place within the plants in the nutrient processes, and no good reasons can be urged why this could not take place in the cell-membrane or cell-contents.

But what proof have we that such absorption does take place? If we do not attribute some such action to the roots of plants, it seems difficult to explain the actions of many manures. When a small quantity of nitrate of soda or sulphate of ammonia is cast over a field of wheat before a shower of rain, the roots of the plant seem to take up the greater part of it during its growth, although the manure is being constantly diluted by every succeeding shower. The particles of the nitrate seem to be absorbed by the membranes of the roots as the water descends through the soil,—something in the same way as would take place if an acid were in solution, and the cell-membrane composed of carbonate of lime. It is clear the roots cannot run over all the interstices of the soil, nor is the soil at any time exhausted of its moisture.

The fact that fresh urine does not have much influence on promoting the growth of plants, indicates, as already stated, that urea either does not have the power of penetrating the cell-membrane

of the roots, or that plants do not have the power of assimilating this substance. In both cases the necessity of reduction to the inorganic condition is essential. Special absorption, as already said, implies chemical affinity between the substances in solution and the roots of plants. It is difficult to conceive how the assimilation of urea or any other matter can take place, unless some affinity exist towards other substances which are already in the plant. Special absorption by roots and assimilation of inorganic substances within plants may be considered as modifications of the same law. Inorganic substances, in this view, therefore, can only be assimilated by plants under the influence of light; and inorganic substances can only be specially absorbed by the roots of plants.

The practice followed by the Italian agriculturists on their irrigated meadows must appear altogether indefensible if special absorption of certain matters does not exist; nor does it appear to us that a correct theory of water-meadows can be made out unless this principle is added.

As we stated in a former article, the *marcite* or winter-meadows of Northern Italy have a very large quantity of water flowing over them. They are frequently dressed with liquid manure which has been stored for some time. It is a very common practice, too, to manure with linseed-oil-cake, reduced to powder, and mixed with lime in the proportion of seven of the former to one of the latter. This mixture must be made at least ten days before it is applied to the land, in order to promote decomposition, and it must be applied some time before the water is admitted in autumn.* At that season the grasses cannot take up one-tenth of the water which is allowed to flow over the fields, and unless the roots really had the faculty of taking up a greater share of the manure than the water which enters the roots, and is evaporated by the leaves, an enormous waste of manure would follow.

Chevandier and Salvétat,† finding that two waters used in irrigating meadows produced very different amounts of produce, analysed them, and discovered that the quantity of mineral matters were actually larger in the water that produced less grass. They referred the good qualities of the water not only to the larger quantity of organic matter which they contained, but more particularly to the larger proportion of nitrogen in the organic matter. In short, the organic matter was nearer the inorganic condition, and the process of decomposition taking place more rapidly when subjected to aeration, and thus permitting the roots to absorb the inorganic compounds from the water, as the leaves do from the atmosphere. The good effects of water cannot have anything to

* *Italian Irrigation.* Captain R. Baird Smith. Vol. ii. p. 95.

† *Transactions of Highland and Agricultural Society.* No. xlv. p. 330.

do with the absorptive powers of the soil, for it is well known that irrigation is vastly more striking in its effects on sands than on clays.

Tanks, then, may be considered as necessary to ferment liquid manure, and to store it until the crops to which it is applied are in an active state of growth. Waste is a necessary consequence of any other mode of procedure; and we believe no very striking results have been obtained, unless the above conditions have been attended to; and further, we are inclined to think that much of the disappointment which has been expressed by many who have tried liquid manure, has arisen from the non-fulfilling of these conditions, and also from applying liquid manure in too concentrated a state during summer. Liquid manure may be applied to clover and grasses in autumn, so long as the plants are in a growing state, even in a concentrated form, with the best results; but dilution is required in summer, because, if an extra quantity of moisture is not given, especially to grasses, they do not have the power of expanding under the otherwise favourable conditions in which they are placed.

No amount of nitrate of soda or guano applied to Italian ryegrass, in the dry form of ordinary top-dressing, has been able to approach the amount of produce which Italian ryegrass has produced under liquid manuring. It is needless to repeat the enormous quantities of grass which have been got by this system. But the statement of Mr Caird, that Italian ryegrass, under this system, is capable of producing 20 tons of hay per acre, is sufficient to demonstrate how far all the results with mere top-dressings are outstripped by adding a certain quantity of liquid.

Since, then, however liberally we may apply guano or nitrate of soda to our grass crops, the amount of produce falls far short of that which can be had under liquid manuring, it is evident that a given quantity of ammonia, largely diluted with water, acquires a greater fertilising power. Similar principles are brought out in other well-known facts.

A ton of nitrate of soda, though it only contains the same amount of nitrogen as a ton of guano, is about double the price; yet from the nitrogen being in a more available form for wheat and grass, its fertilising power for these crops is about equal to two tons of guano. If by any process we could make the fertilising power of a ton of guano equal to one of nitrate of soda for grass or wheat, great economy would be effected. The system of storing liquid manure in tanks for the purpose of fermenting, and keeping it until the crops are ready to take it up when the season of active growth has arrived, not only gives ammoniacal manures as great an effective power as nitrates, when applied in the dry state, but a much greater—simply because by no other means can so much grass be grown on an acre as has been done under irrigation with liquid

manure. The full producing powers of Italian ryegrass cannot be obtained by any other treatment.

The same quantity of nitrogen applied in well-fermented liquid manure, and only when the crops are in a growing state, as at Myer Mill, has a fertilising power imparting to it greater than nitrate of soda, and vastly greater than guano when sown over the land in dry cultivation; we suspect that the liquid-manuring system which Mr Mechi has followed at Tiptree, of throwing the unfermented contents of his tanks over the land at all seasons, though it may be in accordance with the views of the Commissioners of the Board of Health, is not the proper one. So long as this mode is followed, Essex cannot be said to have a fair trial of liquid-manuring. But it must be borne in mind that the growth of turnips is very different from that of Italian ryegrass. Maximum crops of the one, on good deep loams, can be raised with solid manure, but not the other; indeed, one dressing of liquid manure would have to serve for the turnip crop, and it would require to be applied before the crop was put into the ground, because repeated applications would batter the surface.

The application of rich unfermented manure in the solid form is perhaps the best for the turnip. The growth of this plant extends over a very considerable period, and the process of decomposition is probably quite as rapid as the rate of development. Not so with Italian ryegrass, which grows so rapidly in summer that large supplies of food, ready for assimilation, must be given at intervals to obtain its full development.

Liquid manure is just as capable of raising one kind of crop as another, because all our cultivated crops, being in a great measure composed of the same substances, are manured by the same substances. The habits of the growth of cultivated plants are very different, and therefore the modes of treatment in regard to manure must be adapted to suit their habits in our highly artificial systems.

Carbonaceous manures, or inferior guano, from the quality they possess of only slowly yielding up the nitrogen they contain to the wheat plants, are more economical, so far as nitrogen is concerned, when applied as autumn dressings, than better and more soluble guanos. Liquid manure cannot be applied so economically to wheat in autumn, because waste from washing must to a certain extent take place. Top-dressing wheat with liquid manure is out of the question.

That nitrate of soda does not possess any other merit than that of being in the most available form for spring-dressing autumn-sown wheat or grass, is pretty evident, from the fact that guano is the manure almost universally used for manuring spring wheat, as well as barley, oats, or turnips. Only one dressing of liquid manure could be advantageously applied to any of these crops, which

would not differ materially from solid manuring. In regard to mere effect in raising any of these crops, liquid manure cannot be said to have much or any superiority, for it must be recollected that as large crops of either have been grown with solid as with liquid manure. On these grounds we consider the Commissioners of the Board of Health have put forward very exaggerated views of the merits of liquid manure, in not making many important qualifications of their statements:—*

"The more minute division of manures in the liquid form facilitates their rapid decomposition and complete absorption; and there are various examples to show that one load of solid manure, properly liquified with sufficient water, will have four times the fertilising power that it would have if applied in solid form."

Can this system of liquid-manuring be recommended for general adoption? Most certainly not. In all districts where the system of feeding cattle in open courts is practised, and is necessary for converting straw into manure, liquid-manuring is not to be thought of, seeing that the rains must have displaced what escapes. The liquid is obtained by deteriorating the quality of the solid. It is only in those cases that more liquid is produced on a farm in feeding cattle than can be absorbed by the straw that the question arises, what is to be done with it? Which is the most economical way it is to be used in producing crops? There are very few districts in Scotland where the system is at all applicable, and indeed there is but a small proportion of farms where more liquid at the present time is produced than can be absorbed by the straw; still, there are many farms that are in this condition, and they are daily on the increase. Potato culture, no doubt, in some particular districts, has turned the tide in an opposite direction.

The experiments which have been made in Ayrshire and other places upon a very large scale, in liquid-manuring, we have always regarded as being exceedingly interesting, both on practical and theoretical grounds; for no doubt a day will come when the quantity of stock kept on our farms will render tanks and distributing apparatus necessary. It will be strange, indeed, if the

* The strictures Professor Johnston made when this subject was discussed at the East Berwickshire Farmers' Club, on 4th January 1853, have much truth in them. Alluding to the Report of the Board of Health, he says: "I must say that upon the face of that Report there appears an attempt to show only one side of the question—I do not say from design, but the reporters have not, I think, stated the case in the fair manner which would justify a practical man to take it up. It is because of the statements contained in this Report that a more favourable impression has been made on the minds of many proprietors as to the merits of the system than I think it deserves, and that they have been thereby induced to incur expenses with which I scarcely think the profit will be commensurate." The system has been recommended where it is not at all applicable; and we think the Berwickshire Farmers' Club were not without blame, when the subject was so well brought before them, not to have met many of the positions taken up by the Board of Health, in a series of resolutions, stating the practical aspects of the question.

steam-engine will stand idle while the distribution of liquid-manure goes on by the old method, with all its uncertainties.

It is commonly said that the climate of the eastern parts of our island is not so well adapted for liquid-manuring as the western. Indeed, various parties have argued with us that the experiments in our own county, at Burnturk, favour this view, and that it is useless to contend against this natural defect. That a dry climate is not so well suited in many respects for liquid-manuring cannot be doubted. But how far does this objection really extend? Not farther, certainly, than the mere amount of dilution required, or rather, the greater quantity of water which must be supplied to compensate for a smaller fall of rain, or a dryer atmosphere. These natural defects are completely overcome in Italy, and we know from the habits of Italian ryegrass, that something short of complete submersion suffices for maintaining this plant in all its exuberant growth. After a full supply of water is obtained at Burnturk, we shall then expect to have the question answered, What is the extra amount of artificial watering required in Fifeshire to produce as great a crop of Italian ryegrass as can be done in Ayrshire? So long as we hear so much about the deficiency of climate, so much the greater is the propensity to overlook the real elements of success.

It would be out of place here to enter into lengthened calculations as to the economy of the new method of distribution. Difficulties are encountered by those who make trials, which calculations cannot reach. The liability of the apparatus, such as the hose, to get out of order, renders the whole process far from being an easy-working one. But the results of the system, viewed in the mere production of crops, have been seen and appreciated, and simpler methods will no doubt take the place of those which are more imperfect.

Indeed, we have got something more than mere glimpses of the economy in the distribution of liquid manure by the hose and the jet. Moderate calculations founded on results represent the expense of distributing a ton of liquid manure by this process at 2d.,* while by horse and cart it is 6d. per ton. Now, it seems to have been demonstrated that liquid manure in summer must be largely diluted with water to render it certain in its results—say three times its bulk of water is required: thus it would take 2s. to apply this to the land by horse-power, and 8d. by hose and jet.

When one has examined the condition of the farm of Cunning Park in Ayrshire, and taken a survey of the whole arrangements for giving the manure its greatest fertilising value, it would be very hard to suggest another method by which the barren sands on that farm could have been brought more rapidly or more eco-

* Mr Milne Home's Report, read before the Berwickshire Farmers' Club.

nomically under the dominion of fertility than by the system which Mr Telfer has followed.

The experiments which have been made on so many farms in Ayrshire in distributing manure by the hose and jet are of the most interesting character, viewed in reference to the saving of the sewerage of towns. The difficulties which arise in carrying out the system for the farm-drainings or for the town-sewerage are all of a mechanical nature. Professors Way and Anderson give us no hope that any methods which have for their end the precipitation of the valuable materials in town-sewerage, and conversion into solid manure, is likely to be successful. The agency of water, as a means of distributing the sewerage of towns over the fields, appears therefore the only one calculated to effect so desirable an end.

After looking carefully over the Report of the Board of Health, we cannot say they have been successful in showing that the application of the hose and jet by steam-power is preferable to the meadow system, where the latter can be carried out. The meadow system possesses one great advantage, that it economises space, as under no other crop can so large an amount of manure be yearly applied to a given space, and yield so large a net return. On these grounds Mr Smith of Deanston recommended that, where a natural fall did not exist, the sewerage of towns should be raised by scoop-wheels, such as drain the fens of Lincolnshire, and applied to the raising of grass. This seems to be the most practicable plan that has yet been proposed in dealing with this difficult but important subject.

COUNT DE GOURCY'S AGRICULTURAL TOUR.*

THE progress of husbandry on the Continent must ever be a matter of deep interest, not only to the British agriculturist, but also to our statesmen and philanthropists. Although its condition must necessarily vary greatly over so extensive an area, and in circumstances so diversified, it is satisfactory to find that, upon the whole, it is progressive, and in some quarters it is so in a remarkable degree. This is the case more especially in some of the more northern countries, lying in latitudes nearly parallel to our own, where somewhat similar physical conditions require analagous modes of culture. To the south of the Alps, or rather to the south of the ideal line which may be regarded as dividing the countries of milk and butter from those where they are supplanted by oil—soil, and

* *Voyage Agricole en France, Allemagne, Hongrie, Bohème, Belgique.* Par LE COMTE CONRAD DE GOURCY. Paris.

climate, and productions, assume so different a character, that agriculture necessarily changes along with them, and acquires marked features of distinction. Volcanic soils and southern suns, with alternations of seasons in which winter is only a subdued form of summer, give to these countries much in common with intertropical regions; and it is only the more general principles of husbandry, such as are laid down by Virgil in his *Georgics*, that apply to them equally with more northern lands, and which indeed are of universal application. The state of the art in our own Islands, and in neighbouring parts of the mainland, must always have a close connection: they will mutually act and react upon each other, and any important discovery, or improvement in practice, made by either, will speedily become the common property of both.

In the relation in which they have hitherto stood to each other, in this point of view, the Continent has been incalculably the gainer. In this important art, as in so many others, Britain has been the eminence on which light first struck, from which it has been reflected, and diffused among the nations. And it is gratifying to reflect that, while advancing ourselves, we have carried others along with us: that in benefiting ourselves, we have so largely benefited others. The chief ambition for a length of time among continental agriculturists has been to imitate British, and especially Scottish agriculture; and, wherever circumstances admit of it, our own methods are pretty generally in operation. In almost every part of the Continent where husbandry is flourishing, we now find that British implements are well known, and many of those which have the latest improvements have been introduced.* This is likewise the case with the most approved breeds of horses, cattle, sheep, and pigs; and Durham bulls, Clydesdale horses, Southdowns, and Essex pigs, are almost as familiar names on the banks of the Rhine, Elbe, and Danube, as in their native localities. Tile-draining is also practised, and will probably come rapidly into general use, for the want of efficient draining is found to be one of the greatest defects in their system. M'Cormick's reaping-machine seems to have been known and appreciated in Germany as early as in this country. An intelligent *agronome* near Namur, M. Mertens, proposes next year to employ a steam-engine, and work by its means a number of ploughs without the aid of horses. Guano and artificial manures are occasionally employed in many parts of the Continent; but in a considerable district of Germany, traversed by Count de Gourcy, the former appeared to be absolutely unknown.

But, though late in commencing the career of improvement, there is every reason to believe that the progress of many of the con-

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* Germany, according to Count de Gourcy, is an exception to this remark; for he says, "that he could not see without regret and surprise that it was in general so far behind in agricultural implements," (p. 310.)

tinental nations will be rapid. With the example we have set to them, and the knowledge they derive from us, they start from a high vantage-ground; and when they have incorporated our processes, as far as applicable, with their own, they will be in possession of a very complete system. Their agriculture has a much wider range than ours; their soil and climate are much more diversified, and many branches have risen into primary importance which, in a practical sense, are quite unknown amongst us. The traveller continually meets with crops to which his eye is unaccustomed in this country: a vast extent of beetroot and colza (a variety of *Brassica oleracea*), hemp, tobacco, poppy, millet, madder, gold of pleasure (*Camelina sativa*), &c.; and, not the least conspicuous, large fields of Indian corn: even rice has been introduced, and has been found to succeed perfectly in the neighbourhood of Bordeaux. If France be at present behind some other continental countries, such as Flanders, in her agricultural condition, it seems highly probable that she will not only ere long make up her lee-way, but even take a lead in the advancing movement. Many of the most important elements of success are within her reach, and she is now diligently and judiciously availing herself of them. Her economical chemistry has long been in an advanced state, and a systematic knowledge of the branches of natural history bearing on agriculture is much more general than among us. She not only has a system of agricultural education, of which we have scarcely even the vestige, but it appears to be coextensive with the rural population, and to meet their present requirements. She possesses three Regional Schools, each of them of considerable extent, with a suitable staff of professors, whose prelections are further illustrated by several "repetiteurs," whose office may be said nearly to correspond to that of domestic tutors. Rural economy and agricultural legislation form the subjects of one class of lectures; practical agriculture, that of another; a third consists of "Zootechnie," or treatment of animals; a fourth series is devoted to botany, chemistry, and geology; while a fifth comprehends engineering, as applied to farm buildings and operations. While these Regional Schools are suited to the better class of farmers, the farm schools again bring agricultural instruction within the reach of nearly all who are willing to make an effort to attain it. They amount at present to fifty, and are distributed over the country at convenient intervals. As should be the case with every great national interest, affecting so vitally the welfare of the community, agriculture in France is placed under the charge of a special minister; and this department has the benefit of that direct superintendence arising from a judicious distribution of official duties, the want of which is often so painfully manifested in our own country. One of the means by which this member of the government is guided in his proceedings, is

special reports drawn up by competent parties, and in this the French have acquired great skill. Of this we have had examples in the excellent accounts they have given of our Agricultural Shows, and the state of husbandry in Scotland in the present day. They are much in the habit of visiting other countries, and conveying the knowledge of whatever is new or useful to their countrymen.

One of these agricultural tourists is Count de Gourcy, the title of whose work we have given above. He has been an extensive traveller and diligent observer, and the volume in question embodies the result of his observations during a recent tour through various parts of Europe. Several works of a similar kind have preceded the present one, his experience has therefore been extensive, and he is well qualified to give comparative views of the state of agriculture in different countries. He appears to be well acquainted with the state of the art in Britain, and we have thought that a few notices from his work may be useful and interesting to our readers.

There is one department of rural economy which, as practised on the Continent, is considerably different from our own, in some respects perhaps superior, and from the consideration of which we may derive some hints deserving of our attention,—that is the mode of treating cattle, particularly milch cows. The system, however, seems to have originated in the vast supply of fodder and other feeding substances which the mode of farming supplies, and in this respect we cannot expect to be placed on the same footing. One source of this supply is from irrigating meadows, which in some places is carried on to a great extent. One of these irrigated tracts, on the banks of the Moselle, is described by M. de Gourcy. It consists of upwards of 1200 acres, and it will convey some idea of the labour and expense required to complete this undertaking when we mention that the course of the river was turned several times. The result has been, that the most arid sandy tracts were soon covered with turf, and very indifferent and unproductive land converted into beautiful meadows. A few leguminous seeds were sown among the grass, and especially white clover,—also English and Italian ryegrass. The third year, a crop of from 3000 to 4000 kilogrammes of dry hay was obtained from every 2½ acres. On the oldest of these meadows, three oxen of large size were fattened on 2½ acres, and it was expected that four would be fattened on a similar space. Similar meadows are frequently mentioned by M. de Gourcy; and he states that they are cut three or four times a-year.

Maize, or Indian corn, is another source of supply; of all cultivated plants it yields the greatest amount of forage. It is often grown for this purpose alone; but much of the foliage may be removed for use without injuring the grain. According to our author, "when cultivated for green forage, it furnishes, from an

equal extent of surface, a quantity double that of clover, even when the latter is cut three times in the year," (p. 113.) "When cultivated for forage, it is sown like the cereals, with a space of five or six centimetres between the lines. It continues to be sown for forage up to the beginning of August; and it was stated to me, that a surface of 45 ares had produced 32,000 kilogrammes of this excellent fodder; and that a field of 157 ares, under the same crop, had fed for a month 68 head of large cattle," (p. 167.) "It is cultivated on the lands of M. de Saint Sauveur, near Fribourg, in such quantity that the cattle are fed upon it exclusively up to the end of October. This kind of food becomes more agreeable to the animals after it has been subjected slightly to the influence of frost. A strong manuring is necessary in order to obtain an abundant crop of this excellent forage, which the cattle prefer to every other. It yields much milk to cows, makes calves grow and thrive, and is wonderfully fitted for fattening oxen, which, besides this forage, receive only a daily allowance of five litres of a mixture of colza-cake, and different farinaceous substances," (p. 124.) Now, it is important to observe that certain varieties of Indian corn have been grown both in England and Ireland; and, in favourable seasons, the grain has been known to ripen. It could not be recommended, however, as a corn crop in this country; but there can be little doubt that it would grow to a sufficient size to form a valuable addition to our green crops. Its utility in other countries, as shown in the above extracts, should be an inducement to attempt its cultivation here.

The distilleries, and more especially the numerous and most extensive "Sucreries," or sugar-manufactories—the latter of which form a feature in Continental agriculture, which has no counterpart here—likewise yield numerous substances for feeding cattle. The cultivation of beetroot, to supply these sugaries, is one of the most important branches of rural economy. An establishment near Grenoble employs upwards of 11,000 acres of land in the cultivation of beetroot; the immense Sugarie of Saint-Niklos, which employs 5000 people in the works, and in cultivating the lands annexed to it, makes use of two millions of Austrian quintals of beetroot—equal, at fifty-six kilogrammes the quintal, to 112 millions of kilogrammes. Similar works, though of inferior magnitude, abound in most of the European states. The leaves are employed in feeding cattle, and likewise the residue of the roots, after they have been subjected to the processes of the manufactory. Colza, also, another important crop, affords excellent green food for cattle, and its cake, after the oil is expressed, is of a very fattening quality.

These, as well as a variety of forage plants which are little or not at all cultivated in this country, afford great facilities for feeding cattle. They are generally kept, therefore, to use our author's

phrase, in permanent stabulation; never taken out except to get the air, and exercise their limbs. In many farms, where the cereals are not reared, they are not even supplied with litter in their stalls, but lie on a flooring of planks, a little inclined, and grooved transversely to prevent them slipping. Their food generally consists of a mixture of different substances; and, when there is a distillery or sugar-manufactory connected with the farm, the liquid food is frequently conveyed into the mangers by means of pipes. The fodder is frequently chopped, and a mixture of farinaceous substances is usually given, sometimes as much as five litres a-day (a litre is about $1\frac{3}{4}$ of an English pint). M. de Gourcy gives the following account of the cattle, and the mode of feeding, on the farm of M. de Vitard, near Leuze, in Belgium. "The farm contains about 225 acres; the cattle consist of 20 oxen for work, of the Furnes-ambacht breed; and 20 milch-cows, of which three-fourths are Durham cross-breeds. From 14 to 20 of the work-oxen were purchased at Liege, and, being intended for fattening, they are not fatigued with work. This is the reason they are so numerous. They are two years old, and cost 320 francs the pair. M. de Vitard rears this year 18 calves; two males and a female are of the pure Durham race; the rest are one-half or one-fourth of the Durham blood. Without reckoning pigs, but including eight horses, he rears about 130 beasts, large and small, on the produce of 162 acres. He keeps no sheep. I do not believe that there is to be found on the Continent a cultivator who succeeds so well in fattening cattle. By mixing different kinds of food, he renders it more agreeable as well as more profitable to the animals. He boils together a mixture of farinaceous substances in the following proportions:—Malted barley, ten parts; bean meal, six; rye meal, six; farina of beech-mast cake, six; meal of linseed, one; colza-cake in powder, one: in all, thirty parts. He adds to the mixture, before it is boiled, chopped forage, consisting of straw, clover-hay, bean-stalks, the pods of colza, &c.; roots are mixed with these in winter, and fresh fodder in summer. Only half of the dry fodder is boiled; the rest is added to the boiled mixture as it comes out of the boiler, which assists rumination. Before giving this food to the cattle, it is allowed to simmer ten or twelve hours in a well-closed cistern," (p. 350.) Dr Langé, whose farm is at Windhauseroff, in Germany, states, "That his fattening cattle gain in weight 1 kilogramme for every 20 kilogrammes of food consumed by them beyond the ration of ordinary sustenance — a ration which he estimates at $1\frac{1}{3}$ for 100 kilogrammes of the living weight. An allowance of 3 kilogrammes $\frac{1}{3}$ for 100 kilogrammes of the weight of the animal, constitutes what he calls the *nominal* ration for working oxen, milch cows, and growing cattle; the nominal ration of fattening cattle ought to be at least 4 for every 100 of their

weight,—when it is possible it ought to be carried as far as 6 for 100; but M. Langé assures us that very few animals can be brought to consume such an allowance. His system is, to cause fattening beasts to consume the greatest quantity of food possible. To bring them to this point, it is necessary to give them large quantities of cake, and different kinds of farinaceous substances," (p. 100.)

The cows in greatest esteem are those of the Swiss, Bernese, Flemish, Breton, and Norman breeds. They are often crossed with the Durham, and occasionally with the Dutch breeds; and various other kinds, such as the Tyrolese, Hungarian, &c., are met with. The quantity of milk is often very considerable, varying from 15 to 34 litres a-day: the average, with good cows, may perhaps be stated at about 25 litres a-day. M. de Gourcy has a high opinion of the Tyrolese breed. The Mayor of Selloritz, who keeps 320 cows, informed him that the Bernese gave most milk; but that some of the Tyrolese breed were nearly equal. "This race," he says, "pleased me much; their legs are short, and their forms very regular. They are of a beautiful uniform red colour, without any spots. I regret much that neither the Tyrol cow, nor the Dutch race, are included in the numerous collection of cattle in the Agricultural Institute at Versailles." On the property of Dr Crusius, of the Chateau de Saalis, our author found that a dairy of 112 cows yielded a gross produce, in the course of the year 1849–50, of not less than 15,872 francs, the most profitable item being Gruyère cheese, of the value of 7,645 francs. "These cows," he adds, "are of the medium weight of 500 kilogrammes. Their ration is calculated to be equivalent to 15 kilogrammes of dry hay. They are managed during the winter in the following manner:—At four o'clock in the morning the byres are cleaned; at five o'clock the cows get a little straw, then a feed of cooked food: they are milked at seven o'clock. During this operation they receive hay; at noon, cut beetroots mixed with chopped straw. In the afternoon the treatment of the morning is renewed. The cows get hay during the night; they are milked twice a-day.

"The experiment of food fermented up to the vinous state, has been tried on 20 cows, for five months; 20 others, chosen as like as possible to the former, received at the same time the same food not fermented. The first lot produced 34 hectolitres of milk, while the second yielded 42," (p. 284.) In those farms where special attention is paid to the cows, a Swiss cattle-man is brought from Switzerland to attend on such as are brought from that country.

An epizootic malady attacks the cattle in Germany and other parts of the Continent, and is often very destructive. M. de Gourcy states that on one farm the whole stock, amounting to 145 beasts, was carried off, except five. This formidable disease, named by the Germans *die Loser Dürre*, is so very infectious that,

when it breaks out in any locality, all the people employed in tending the cattle are prevented holding any intercourse with others; the gates of the farm are closed, and they are shut up with their charge. They furnish the cows with all they need, but are interdicted from setting foot beyond the court, so much do they dread the diffusion of the tainted air. M. de Gourcy had an opportunity of being present at an autopsy of a valuable cow, which had been carried off by this disease. It had been contracted while at pasture, from some horned beasts brought from the neighbourhood of Pesth by a butcher of the place, although they did not approach very near it. According to the veterinarian who made the examination, the disease is an inflammation of the stomachs, more especially the fourth. The food in it becomes completely dry; the interior membrane of the stomach continues collapsed even after it has been extracted; the liver is softened, and of a yellowish colour; the interior vessels are full of blood; the bile liquid, and its green colour changed into yellow. The animals seized with this malady are dull; they cease to eat; a burning thirst devours them; diarrhœa soon comes on; the milk diminishes in quantity, then becomes dried up altogether. The Doctor adds, that this disease is exceedingly contagious; neither purgatives nor any irritating medicine must be given; the only efficacious remedy consists of oily and mucilaginous drinks. Among the cattle seized, if left to themselves, from fifty to seventy in the hundred usually recover. The race of the steppes, the same as the Hungarian, is that in which the greatest number of cures are effected; those of the Swiss breed recover with much greater difficulty.

M. le Baron Mertens, of the Chateau d'Ostin, near Namur, is a great partisan of the homœopathic system of treating diseases: he has applied it to the treatment of cattle, and he assures our author that he has found it succeed wonderfully.

The rotation of cropping is usually very different from ours, as might be expected from the different kinds and greater variety of the crops reared. It extends from 5 to 6, to a series of 13 or 14 years. A few instances of the succession of Continental cropping may be interesting. M. de Saint Saveur, who possesses a farm not far from Fribourg (in Brisgau) adopts a 6 years rotation, namely, 1st year, colza, beet, carrots, or potatoes, strongly manured; 2d, barley, or March wheat; 3d, clover; 4th, wheat; 5th, Indian corn, vetches, poppies, manured; 6th, rye, to which succeeds a crop of red clover or turnips. M. Weber, near Baden, follows a rotation of 8 years; 1st year, weeded crops, consisting of potatoes, Indian corn for forage, and a mixture of vetches, pease, and oats, for fodder; 2d, wheat; 3d, red clover, cut thrice; 4th, wheat; 5th, colza, manured; 6th, wheat; 7th, beet, and poppies sown in lines with half manure; 8th, oats. "His poppies sown in lines, he informs me, yield more grain than when sown broadcast, although the latter

appear to be thicker. His oats are magnificent; they are the white Hungarian species; and he follows them with a crop of red clover, replaced, the first year of the rotation, by the Indian corn and mixture of leguminous plants." (p. 115). As an example of a 14 years rotation, we give that of Dr Langé at Windhauserhoff, 1st, fallow, manured with 23,000 kil. of dung per hectare; 2d, colza, sown in lines and twice weeded; 3d, rye; 4th, vetches; 5th, weeded crops, with the quantity of dung just mentioned; 6th, barley; 7th, 8th, and 9th, lucerne, mixed with sainfoin; 10th, potatoes; 11th, Indian corn, barley or oats; 12th and 13th, white clover, mixed with grasses, pastured with sheep; 14th, wheat.

A peculiar method of drying clover, and other green crops, is followed in some parts of the Continent; and perhaps some similar plan might be adopted with advantage in our stormy and variable climate. Our author first observed it on the property of the Margrave Maximilian of Baden, near Carlsruhe. It consists of a kind of frame or rack formed of three poles about 3 metres 33 centimetres in length. Two of these poles bear a row of pegs, about 60 centimetres from each other, commencing at one metre from the ground. The third has two rows of pegs placed at the same height as the preceding; a strong peg unites the three poles at the top. This tripod is set upright, placing the bottom of the poles at proper distances. Poles of sufficient length are placed on this frame at different heights, having for their point of support two of the pegs of the poles; the whole length of these poles is thus furnished with projecting sticks or pegs. On the evening of the day on which they begin to mow the clover or lucerne, the whole of the forage cut in the morning and lying in swathes is lifted and put upon this frame on the traverses. Care is taken to begin with the lowest stage, and to leave the centre open. All the stages and poles are covered successively; but the thickness of the forage being much less on the upper part of the frame, it is not necessary to leave there empty spaces. If the herbage is well arranged, it ought not to leave any part of the wood composing the triangle exposed to view; the whole ought to present the appearance of a cock of hay, such as is made to prevent half-dry hay being injured by rain or night dews. This arrangement completed, no further care need be taken of the forage, whatever be the state of the weather. Even in the heaviest and most prolonged rains, the exterior only of the mass will be a little discoloured; the interior will undergo no change. When fine weather returns, the hay may be rendered perfectly dry, and in the best condition. When the weather is uncertain, a quantity of herbage necessary to yield about 100 kil. of dry hay is put on each triangle; in fine weather a greater quantity may be put upon them. This mode of haymaking is considered by M. de Gourcy the best he is acquainted with; and he was assured by many farmers who had adopted it,

that it is not more expensive than the ordinary method,—many of them indeed affirmed that it is less expensive. He was further informed at Hohenheim, where all the hay is dried on tripods of this description, that, when thus treated, the hay is of so superior a quality that it brings a higher price in the market.

It is satisfactory to find that farm-servants, and others employed in rural affairs on the Continent, appear to be so frequently in comfortable circumstances. A great many practise the *petite culture* on pieces of land which are their own property; and when they work for others, the wages and other allowances afford a very fair remuneration. M. de Gourcy has noted down the rate of wages in many different places. On a farm near Fribourg, the steward, or acting superintendent (*maître-valet*) receives 400 francs a-year; the day-workers, 1 fr. 25 cen. per day in money, and, besides, bread and wine at breakfast and dinner: the allowance of wine is about $\frac{2}{3}$ of a litre. The daily wages of the women is from 65 to 73 cen., without food. On another property near Niederbronn, labourers of ordinary strength and skill gained 1 fr. 50 cen. a-day; women about 1 fr. In some parts of Moravia the workmen are better paid than in many other places, owing to the demand for labour created by the numerous manufactories; those employed on farms gain 1 fr. 27 cen., while at Sellowitz, a day's wages is only 85 cen., and sometimes not more than 54 cen. The women are sometimes employed in rural operations which with us are commonly assigned to the other sex. "We have met at every step with meadows very skilfully irrigated; the women of the country about Saltzbourg, wearing hats like those of the men, were employed in mowing the meadows with the scythe, which they did as well as workmen of the other sex. I never before saw women so employed," (p. 154.)

It is not an unfrequent practice with the more extensive and eminent agriculturists, to receive a few young men into their houses to be instructed in husbandry. M. Turc, at St Genevieve, about 2½ kilimetres from Nancy, habitually boards 15 young men, whom he carefully instructs in agriculture. They pay at the rate of 600 fr. a-year for their board; but they do not work on the farm. This agricultural school has three professors. Dr Langé, formerly spoken of, also takes in a few pupils, to whom he gives board, lodging, and instruction, for two fr. per day. In other cases, as on a farm near Teschen, not far from Dresden, young men acquire a knowledge of their profession by engaging in the works of the farm; 30, so employed, in the place just mentioned, paid 112 fr. 50 cen. a-year as board: two professors attended this school.

We are acquainted with intelligent farmers in the south of Scotland, who, after giving a fair trial to furrow-draining in parallel lines, have reverted to the old practice of carrying them in a diagonal direction across the ridges. They have satisfied themselves, by

repeated experiments, that they can drain most effectually in this manner, and with a great saving of expense. It would appear, from what is stated by our author, that the experience of Continental farmers has led them to the same conclusion. "My attention was drawn to the drainage of a piece of land of about 10 acres. The establishment (at Hohenheim) not having machines for making tiles, they have drained with stones, which are not common in this place. The English method of cutting the drains in the direction of the greatest slope of the land has not been followed; on the contrary, they can open transversely to the slope," (p. 142.)

It is gratifying to find agriculture held in such high esteem on the Continent. This is manifested by the public honours conferred on those who have successfully prosecuted the art, and advanced its interests by new discoveries, and works illustrative of its principles. A statue has been erected at Nancy to Mathieu de Dombasle, a distinguished agronome. The name of Von Thaër is known to our countrymen by his work on the *Principles of Agriculture*, which is admitted to contain a great mass of valuable practical matter, and of which an English translation has been published. "After our arrival at Leipsic," says M. de Gourcy, "the members of the Agricultural Congress, along with the authorities of the city, assembled round the statue, still veiled, of Albert Thaër. The statue was then uncovered, and inaugurated by numerous orations; one of these was by his son, M. Thaër. The statue of this celebrated agriculturist is in bronze, of colossal dimensions; it stands on a very beautiful public promenade. After the ceremony we separated, having saluted the monument with our acclamations," (263.)

AN ATTEMPT AT AN OUTLINE OF VEGETABLE PATHOLOGY.

By T. Lindley Kemp, M.D.

[*Concluded from p.* 28.]

Section VIII.—*The Inflammations of Plants.*

Sudden and rapid Diseases not produced by contagion, but generally by cold or mechanical irritation, not attended by external exudation, and generally, if fatal, ending in mortification.

When our knowledge of vegetable pathology is extended, we shall almost certainly define plant inflammation as, to a certain extent at least, a modification (perversion perhaps is almost too strong a word) of nutrition. Although an abnormal state, yet, when kept within certain limits, it exercises a most useful action, and is indeed the means of repairing injuries, and is also taken

advantage of by the cultivator of fruit-trees in order to bring about an economical result. The healing of wounds and grafting are of course referred to. However, as far at least as we know, this process of inflammation in vegetables has been very little examined, and the following short outline gives perhaps all that is known regarding the subject.

When a branch of a tree is severed, or when a less considerable breach of continuity of surface is made, we might naturally expect that the sap proceeding from the leaves would escape into the air, and go on so doing until so much of it would escape that the plant would die of starvation. Such, however, is very rarely the case, and is almost confined to two diseased states soon to be alluded to—acute fluxes and dropsies. Probably all healthy sap contains an albuminous principle, which, as long as it is a part of the vital fluids of the plant, is in a soluble state, but which, when separated from its natural combination and exposed to the air, solidifies. Every one is aware that this is the case with animals' blood—a clear fluid in the living body, and a mixture of a fluid and a solid after having been removed from the living body. When a number of vessels containing blood are severed—as, for example, when a finger is cut—the reason that the bleeding is arrested is, that the coagulated part of the blood becomes solid, and stops up the wounded orifice or orifices. When an animal dies immediately from a wound, or bleeds to death, it is (at least in almost every instance) because the impetus of the blood from behind is so great as to wash away the albuminous plug almost as fast as it is formed. In plants the same thing occurs; some of the albuminous portions of the sap coagulate on exposure to the air, and, when they have become partially solidified, impede the farther exit of fluids, or the farther escape of more sap. In plants, the force of the circulation is, as compared with that of animals, so feeble that the plug is rarely, save in very peculiar cases soon to be brought under notice, washed away. This albuminous matter, thus deposited between two cut edges, is not entirely devitalised, but in both animals and plants soon has vessels put into it from the neighbouring tissues, which vessels convey blood in the one case, and sap in the other, to nourish it. It soon becomes a compound vegetable or animal texture, like other parts of the tree—wood, bark, skin, muscle, &c.; but the reparation is seldom quite perfect, and the healed wound has a different appearance from the adjoining parts ot the same kind, and is usually called a scar. This process of reparation is called one of healthy inflammation, and its successive progresses, with their accompanying phenomena, have been diligently studied in animals, but not in plants. A change of a similar nature may occur without the laceration or wounding, but spontaneously, as it were, and it then constitutes the disease that we call idiopathic or self-originating inflammation.

Inflammation, then, is the great means provided by nature, 1st, To prevent bleedings to death from the numerous accidents to which animals and plants are liable; and, 2dly, To enable them to repair breaches of continuity. It is only when its action is excessive that it can properly be said to constitute a disease. When very excessive, however, its intense action speedily destroys life by its effusions stopping the respiration or circulation, or by its producing mortification.

In the case just supposed, where a finger is cut, the blood flowing between the two cut surfaces unites them. But if we cut away one of the surfaces, and supply its place with a piece newly cut off from another person's body, the same result takes place. This, too, is the case with plants; is often artificially done—and when this is managed, it constitutes grafting.

The sequence of changes that probably takes place may be thus stated: 1stly, After the injury there is an increased flow of sap; 2dly, Exudation of its watery ingredients, and deposition of albuminous matter; 3dly, The flow of fresh portions of sap which pass by means of canals that are formed in the deposited albuminous matter, nourish it, and gradually convert it into structure of the nature of that immediately adjoining it. An analogous state of matters unquestionably occurs in the case of animal wounds. If, however, the violence of these actions is very great even in an otherwise healthy plant, they, like all other excessive actions, as excessive heat, lightning (*i. e.* excessive electricity), &c., destroy the affected structure. And perhaps if the plant be in a weak state from deficient supplies of food, or other cause, a far less amount of such local violent action may induce this local death, or mortification, as it is termed.

The action of cold in producing plant inflammation is sometimes perhaps to be ascribed to the reaction that occurs after the diminished circulation of sap that it has caused. The existence, however, of such a *vis medicatrix* in plants has scarcely been inquired into. At any rate, in many such cases the affected part (or the affected whole plant) would seem to mortify at once, without passing through the previous congestive and effusive stages. It is also important to remember, that the action of cold in exciting inflammation is much less marked if the reduction of temperature be gradual, than if it be made suddenly. As may easily be supposed, a plant in a bad state of health, and having, in consequence, a deficient circulation, and therefore a lower temperature, is more readily affected by inflammation than a plant of the same species in its ordinary state of health, and therefore having its ordinary temperature. It is, too, in both cases, not the amount of reduction of temperature, as indicated by the thermometer, but the rapidity with which the reduction takes place, that produces the mischief.

1. *Inflammation of Fruit ending in mortification, and generally caused by the alternation of cold nights and hot days.*

Fruit, particularly the more delicate varieties, are sometimes attacked with a sudden illness, which causes them to very rapidly putrify. It appears to be an intense inflammation, ending very speedily in mortification. Unfortunately, the exact series of changes that occurs between the application of the cold, followed by the heat, and the commencement of the rotting, have not been studied.

2. *Dry Gangrene. Inflammation of all or part of a plant ending in dry gangrene, and usually arising from exposure to sudden and severe cold.*

In the case of the last-mentioned disease, the inflammation appears to be excited by the sudden return of heat after it has been in an unnatural state of cold—*i. e.* diminution of heat—and the inflammatory reaction kills it. In the present case, the plant appears never to fairly rally so as to allow inflammatory action to be strongly developed. Hence it may be doubted if the disease is, properly speaking, an inflammation; but as exactly analogous cases occur in animals in which there is no reaction, but which are unquestionably of an inflammatory nature, it is almost certain that this dry gangrene is in plants really an inflammation. In this affection the leaves and stem become black and withered, and the due performance of the functions of both being thus arrested, the plant, of course, soon dies. Of the same species of plants, young ones are more liable to suffer from this affection than mature ones. Portions of plants also become occasionally affected in this manner, and slough off, in which case the albuminous matter of the sap coagulates at the surface of the part whence the disjunction has taken place, and becomes gradually converted into bark.

A disease having the same result, and very probably of the same nature, occurs in peaches and apricot trees. In this affection, large branches suddenly become affected with dry gangrene and drop off. It may be that these delicate fruit-trees are affected by the fall of the temperature, although the amount of the heat in the atmosphere gives to us an agreeable feeling. This disease in apricots occurs, we believe, only, or nearly only, in summer.

It is very probable that idiopathic inflammations of particular organs occur in plants, but we possess little or no definite knowledge regarding their phenomena and progress.

SECTION IX.—THE HEMORRHAGE AND DROPSIES OF PLANTS.

3. *Fluxes, Hemorrhages, and Acute Dropsies. Exhalations (without wounds or external injuries of any kind) of sap or other fluid that flows pretty rapidly, and which usually run a speedy course.*

It is almost certain that fluxes are produced in plants by two

quite opposite states of the system. One form appears to be of an acute nature, and to depend upon a state of plethora, and to be very analogous to inflammation, at least in many of its phenomena, but not characterised by albuminous and reparative effusions. The other form appears to be of a chronic nature, to depend upon debility, and to have no true inflammatory features. The varieties of the first-mentioned kind fall to be considered here; our knowledge regarding this class of diseases, however, is very small, and even that little very ill defined.

(1.) *Watery flux.*—A profuse discharge hitherto usually observed in vines during spring in cold climates. It is rarely fatal, suddenly disappearing with warm weather. This is sometimes called lachrymation. As the vine does not lachrymate, at least to any extent in warm countries, this affection, which occurs during spring in cold countries, would seem to arise from the radicles absorbing a greater quantity of water and other nutriment than the plant can assimilate, but an amount, nevertheless, which it could assimilate were it living in a state of nature, in a sufficiently warm climate. The discharge rarely prevails to such an extent or continues for so long a time as to prove fatal.

(2.) *Gummy flux.*—A profuse discharge of gum in fruit trees. This disease is principally to be observed in stone-fruit trees. Perhaps we cannot do better than quote Mr M'Intosh:—

> The chief, and apparently the only disease to which the cherry is subject, is the gum or exudation of gummy matter on the stem or larger branches. This is attributed to wounds, too highly manured soil, and sometimes, probably, to the difference between the tree and the stock it is wrought upon. When the bark of the cherry is wounded in spring before the foliage is developed, whether by contusion or severe cutting, water is apt to find its way into the injured part, and prevents the natural healing at the time of the sap's ascent; extravasated sap exudes from the part, and forms that gummy appearance known as the gum. When the soil is too rich, the sap is thrown into the stem and larger branches faster than the circulating branches can carry it away; some part or other of these become ruptured by the force of the sap within, and as it exudes through the ruptured part of the bark, it assumes the gummy appearance. Root-pruning, and replanting in a less highly enriched soil, are the only remedies in this case, for the cherry, of all fruit trees, is the most impatient of a rich soil. The difference between the tree and stock acts much in the same way as an over-rich soil; when the stock is of a nature to throw more sap into the tree than it requires, the same consequences follow; and when it sends up an insufficient supply of sap in spring, in consequence of the sap-vessels being too small to admit of its free ascent, the tree would show evidence of its diminished supply by the smallness of its shoots and foliage; but this is made up by the leaves, which draw a considerable share of their nourishment from the atmosphere. The returning sap, however, is impeded in its descent in autumn at the point of union of the stock and graft; the vessels become there often greatly distended, producing those protuberances so frequently seen on cherry trees; the weaker vessels then often become ruptured, extravasated sap exudes, and forms into a gummy substance. The cherry on its own roots—that is, directly originated from seed—lives to a considerable age, and often attains a large size, but seldom when budded or grafted, more especially if on stocks originated from seed of the cultivated sorts.—*Book of the Garden,* vol. ii. p. 545.

(3.) *Honeydew flux.*—A profuse discharge of saccharine fluid from the leaves (usually in hot weather), and which sometimes

destroys them, and causes them to fall off. This is an exudation of a saccharine matter, which covers over the surface of the leaves, and not only of itself impedes their functions, but by its adhesive nature causes all sort of dust and the like to fix there, and, by checking the inspiration and the expiration, thus impedes the due performance of the breathing. The disease has been principally noticed in peaches and nectarines, and to occur in them principally in hot and dry weather.

(4.) *Barley flux.* — A pretty profuse discharge from young barley plants, which, however, usually soon ceases. This disease, although its occurrence is unquestionable, has been very little investigated, or indeed noticed. Perhaps the best plan is to quote the description of one of the very few who have observed it. "A clear liquid," writes Stephens,* "at times transfuses from the points of the young barley plants, which is mistaken for dew. Its nature has not yet been chemically examined." Still less has it been examined pathologically, but it appears to be essentially an acute dropsy.

B. Chronic Diseases, in which the symptoms are protracted, and for some time not very severe.

Any one who has read the preceding pages of this article will have observed the vagueness of our knowledge regarding many of the acute diseases of our cultivated crops, partly arising from defective observation, but still more, perhaps, from the want of attempts at generalisation of what has been observed and is known. But when we come to inquire into what is ascertained regarding chronic vegetable diseases, we find it even far less, both in extent and precision, than with regard to those of acute ones. This is partly owing to the symptoms exhibited being less marked, and therefore exciting less attention, and still more probably to the much greater difficulty of the subject. Even in human medicine, which has for so long been attentively studied by men who made it the business of their lives, the knowledge regarding chronic human disease is very limited, and often very incorrect; and the consequence is, that human medicine can do far less good, and in most cases little of permanent good, in the treatment of chronic disease in the human species. But little satisfactory, then, can be expected regarding chronic vegetable diseases; still, if the subject were carefully attended to, there can be no doubt but that important facts would be ascertained, and important generalisations deduced from these facts, the practical result being a great economical saving, for it is probable that chronic diseases diminish the produce of our cultivated crops far more than acute ones. This attempt, then, to place

* *Book of the Farm*, vol. ii. p. 252.

in one view, and to systematise what little we know about chronic vegetable diseases, may perhaps be of some use.

The following preliminary general observations, although unfortunately vague enough, regarding the chronic diseases of our crops may save repetitions.

Alteration in the equilibrium of the circulation or local determinations of sap is either the beginning of the series of changes that constitute the essence of many chronic diseases, or it comes on very early in their course, and is *one* of the causes, or *the* great cause, of danger. Local determination of sap occurs in many instances naturally, and produces no ill result. Thus, during the formation of the flower, and still more at the end, the quantity of sap that passes through the vessels of the flower in a given time is far greater than at any other part, and it is probable that, during the growth of leaves, buds, &c., there are local determinations of sap. In these instances there is perfect health; but there are abnormal local determinations or plethoras that occur in plants, and produce much mischief, particularly as producing morbid effusions, as dropsies and many chronic dispositions. Then the secretions of the plant may become altered in quantity or quality, and thereby gradually impede the due performance of some essential function, and in consequence ultimately induce death. In other instances it would seem that the sap, from some cause or other, becomes degenerate, and is daily failing to nourish quite sufficiently for the wants of the plant; and in this case we can easily understand how there should be disease first, and, after the disease has lasted for some time, death. But the great cause of chronic vegetable disease would appear to be some perversion of the powers of nutrition, in consequence of which a due quantity of fresh nutriment is not added to the proper structure at the proper time (thus giving rise to atrophy, &c.), or at other times too much is added (thus giving origin to hypertrophy, &c.); or, which seems still more injurious, morbid matter is added at places, or formed from the sap at those places, and which morbid matter constitutes malignant growths, or hardening or softening are thereby induced.

With regard to the causes of these chronic morbid actions our knowledge is very defective. Improper aliment—it may be sometimes perhaps improper because it is in excess, but usually because it is defective in quantity—is probably a great cause. A defective state of the air is also sometimes another; but the cause in general seems to be some morbid but as yet unknown state of the sap. Another fact regarding chronic disease in plants, but one that appears quite inexplicable, is, that when once it has begun it generally tends to extend itself; and, moreover, if it disappear from a particular plant, that plant is more liable to become attacked by it than one that never has been so affected. Then another fact that is quite certain is, that if a particular plant be liable to a particular

chronic disease, plants grown from it or its progeny are also liable to it. This has particularly been noticed to be the case with many fruit trees. Lastly, almost every genus of plants has a particular soil in which its members best flourish; and if they are not situate in that soil, they are liable to disease, and do not thrive—*i. e.* do not properly assimilate. A better instance of this could not perhaps be brought forward than that beans will not succeed on a sandy soil, nor rye on a heavy one, and *vice versâ.* In the present state of our knowledge this is inexplicable.

Chronic diseases may terminate fatally in plants,—1st, By obstructing the circulation of the sap; 2d, By impeding the respiration; 3d, By diminishing the powers of the function of nutrition; or, as is perhaps often the case, by a mixture of two or all of these.

We now proceed to the enumeration of special chronic diseases, the existence of which seems well established.

SECTION X.—CHRONIC DISEASES OF THE ORGANS * OF RESPIRATION AND CIRCULATION.

This class of chronic diseases has been so little investigated that scarcely anything satisfactory can be stated about them.

1. *Premature Defoliation. A disease in which the leaves in annuals, biennials, and deciduous perennials fall off too soon.*

The leaves of these classes of plants seem sometimes to be attacked by a kind of chronic pneumonia, the result of which is greater or less destruction of the respiratory apparatus. If this destruction occur to a great extent, particularly if this happen some time before the natural season for the leaves to fall off, death is necessarily induced. The disease was known to Wildenow nearly half a century ago. He entitled the affection *defolatio notha.* "In whatever way," he wrote, "it may happen, all depends on the nature of the plant affected with it, and on the season of the year in which it happens. If it be a fast-growing tree, and the injury happens before August, the tree may, if taken good care of, easily get leaves again, only it will have smaller foliage for the present season. But if the leaves fall after that period, and cool weather comes on earlier than usual, or if it happens at a much later season, the plant may be unwell for several years before a complete recovery takes place. If, on the contrary, it happens late in autumn, just before the natural fall of the leaves, then it has no bad consequences, except the plants be natives of a warmer climate, and the branches which have appeared already be not yet

* The expression used of *organs* of circulation is meant to include the morbid changes that take place within these organs.

hard enough, in which case they will lose those branches, and perhaps some of the older ones, by the invasion of cold."

As evergreens do not naturally tend to shed their leaves at any particular season of the year, but continuously, they do not appear to suffer so much as other plants from this affection, but sometimes, nevertheless, they do appear to be killed by it.

2. *Mildew. A disease of the leaves, in which a white deposition appears upon the leaves of a young plant, which is followed by a stunted stem and an ill-developed blossom and grain. Wheat is particularly liable to this affection.*

A similarly named, and probably a similar disease, attacks the leaves of cabbages, peaches, vines, and other cultivated plants. In all these cases various minute fungi, as a Puccinia or a Botrytis, may be seen growing on the mildewed parts, but (see No. XLVII., p. 609) there is no evidence that the fungus causes the disease, or has any connection with it, save in living in the dead structure produced by the disease. In the case of mildew, in which the following symptoms and appearances occur, the surface of the leaves and also of straw becomes so affected that they are disorganised to a considerable extent, and these functions so destroyed that the grain cannot be formed at all, or only imperfectly. It has sometimes caused very great damage; and a good report on mildew, free from any preconceived opinions regarding its connection with parasitical fungi, is a desideratum that is to be lamented.

3. *Rust, a similar or analogous affection to the above, but in which the deposition on the leaves is red.*

This disease appears on the leaves and also the stems of many plants, as wheat, oats, &c. It is also said to have been noticed on wild plants. A fungus, or many fungi, certainly appear in the course of the disease. It, like the preceding, is a disease of the respiratory organs, regarding which nothing definite appears to be known.

The disorder called rust in carrots does not seem to have any connection with the true rust. It consists in the plant being destroyed by its root being almost entirely consumed by the larvæ of the carrot-fly (*Psila rosa*). Other insects enter the cavities that this one has made, and complete the mischief..

4. *White Sickness. A gradual disappearance of the green colour of plants mainly caused by a deficient circulation from want of proper food.*

This disease may very often be witnessed, and as it may be removed by the addition of food to the roots of the affected plant, is owing to exhaustion of the sap. The white colour produced by absence of light is a different affection; but as it is the effect of either design or accident, it scarcely constitutes a disease.

5. *Red Sickness. An analogous disease to the preceding, in which the surface becomes red, mainly caused by an impeded or deficient respiration.*

This disease certainly appears to have an existence, and its true pathology would seem to be thus correctly stated; but it has been little investigated.

6. *Fissure. A semi-inflammatory affection, in which some of the solid parts of a tree separate into an oblong cleft.*

It is caused by an excessive accumulation of sap. It sometimes becomes very chronic, and runs into an ulcer like a chilblain, particularly if it is exposed to frost. The fissure degenerating into a chilblain appears to have been especially noticed in oaks. The ordinary fissure has been principally noticed in pear-trees, particularly in the United States and in France. Its common name in the former place is frozen-sap blight, but in all probability without any reason. Live sap cannot freeze. Duhamel ascribes it more justly to an excess of sap; but when the disease is better investigated, there will probably be detected a semi-inflammatory condition of the affected tree. The following is Duhamel's account of it in the pear-tree: "The sap, corrupted by putrid water or the excess of manure, bursts the cellular membranes, in some places extends itself between the wood and the bark, which it separates, and carries its poisonous acrid influence to all the neighbouring parts like a gangrene." Downing thus describes what we suppose is this affection as occurring in America: "In a soil over-moist or too rich the pear is always liable to make late second-growths, and its wood will often be caught unripened by an early winter. For this reason this form of blight is vastly more extensive and destructive in the dark rich soils of the western States than in the clayey and poorer soils of the east. And this will always be the case in over-rich soils," &c. Mr M'Intosh has noticed the disease in this country among tender varieties of pears planted in cold situations but in a rich soil, the combination of the two circumstances producing a tendency to grow too long in the season. All these facts go to indicate a too plethoric state as the cause of the disease, and justify it being put down as semi-inflammatory.

7. *Chronic Dropsy. Swellings from effusions of liquid of a non-inflammatory origin.*

These swellings occasionally occur in various organs. Bulbous roots are liable to it; so are occasionally fruits and young seeds. In this last-mentioned case the seeds do not perfectly ripen. Roots and fruit affected with it have a great disposition to mortify. This meagre account seems to contain all our knowledge upon the subject.

Of course, in speaking of vegetable diseases, the wood dropsy is

not exactly correct. The diseased state called dropsy in animals is not (as in this disease) caused by excess of fluid deposited, but by imperfect action of the absorbent vessels not duly removing as much as they ought to do. As plants have no intestinal absorption, true dropsy cannot occur in them.

SECTION XI.—CHRONIC DISEASES OF THE ORGANS OF ASSIMILATION.

In all probability this class of diseases causes more mortality than all the rest put together; and it is some degeneration of the assimilative powers that in the majority of cases causes death. But our knowledge regarding these affections is very small: one great reason of this being that we know so very little regarding the processes of digestion, assimilation, and nutrition in plants. That soil can be taken by the plants, and the elements of it arranged in fresh combination so as to form sap, we know; but we scarcely know more than the fact; that the elements of this sap can be again arranged and put together so as to form the various tissues, we also know; but of the stages of the process we are ignorant. As every vital action is liable to be disordered, and become either in excess, or the reverse, or in some other manner modified, we can easily understand that there should be many and important chronic diseases of assimilation in plants. Those mentioned in this sub-section seem referable to this head.

1. *Ergot. A disease occurring in grasses, barley, and especially in rye, in which the young grain becomes first white and then black.*

The darkened diseased grain contains no starch or albumen, but a peculiar substance. As the product of this disease in rye, *ergotted* or *spurred rye*, is used in medicine, its origin and causes have been more particularly investigated than any other diseases belonging to this group, and we therefore dwell here upon it at greater length.

The spur generally attacks the rye in damp weather, and in damp clay-soils (*i. e.*, the very worst possible for rye). It has been particularly noticed in heavy unfertile soil that has been lately brought into cultivation in the neighbourhood of forests. The locality where it is so prevalent as to form a fourth, or even a third, of the whole grain in bad years, and even in good seasons a forty-eighth part, Sologne, "is intersected by hills of wood around the fields;" "the arable land is so poor that, although it lay fallow every third season, it was exhausted in nine or twelve years at farthest, and then remained a long time in pasture before it would again bear white crops;" and the surface was so wet and level that crops were procured only when the seed was sown on the tops of furrows a foot high, as the climate is so moist, that from the month of September to late in spring the whole country is overhung by dense fogs.

So many grains in each spike, usually from three to ten, become ergotised. "The spur," says Christison,* "varies in length from a few lines to two inches, and is from two to four lines in thickness. If it is long, there is seldom more than one or two, and the remaining pickles of the ear are healthy. But the ears which have small spurs have generally several, sometimes even twenty; and when there are many, few of the remaining pickles are altogether without blackness at the tips. The substance of the spur is of a dull whitish or grey tint, and is covered by a bluish black or violet husk, having two, sometimes three, streaks of dotted grey."

Spurred rye is heavier than water, and therefore sinks in it. Its taste is slightly acrid, but unpleasant, and the odour of a quantity (the smell of one grain is not detectable) disagreeable and fishy. Its form is cylindrical, or slightly triangular, curved like the spur of a cock (whence its name), and often irregularly fissured: it is black superficially. Various analyses have been made of it, but none are very satisfactory. The actions of spurred rye upon the animal economy are very remarkable, but do not call for notice here.

A parasitical origin has been assigned to ergot, as, indeed, to almost every plant disease, but apparently without any foundation. It is clearly a disease of assimilation. A very curious fact, and which perhaps may have an important bearing upon its nature, is stated by Mr Lawson of Elgin:† "I have never seen the slightest appearance of stamens in a floret containing ergot, neither is there any appearance in ergot of the two cups or sacs which are in the sound seed."

Of the grasses that have been attacked by ergot, the following may be enumerated: Timothy grass (*Phleum pratense*), meadow and jointed fox-tail grasses (*Alopecurus pratensis* and *A. geniculatus*), fiorin grass (*Agrostis alba*), the hard fescue grass (*Festuca duriusculus*), common ryegrass (*Lolium perenne*), and cock's-foot grass (*Dactylis glomerata*). If, according to the generally received opinion, ergot has a poisonous effect upon cattle, it seems strange that the diseases it produces have not been more frequently witnessed. The disease is also said to have occurred in wheat.

2. *Smut.* *A disease of wheat, in which more or less of the grain becomes converted into a dark greasy powder, with a fetid smell.*

In this affection the place of the kernel of the wheat is taken by a brownish-black powder with a greasy feel and a disagreeable smell. In it, according to Mr Lawson of Elgin, the anther never

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* *Treatise on Poisons*, 3d edition, p. 830.

† *Quarterly Journal of Agriculture*, 1848, p. 387.

protrudes beyond the corolla. It is without doubt a disease of nutrition; and for some interesting observations made upon it, reference is made to Mr Lawson's paper in this Journal for 1846, p. 441, and following.

3. *Blackears. A disease of cereals, in which the young ears become coated with a black degeneration which sometimes extends to the whole grain.*

Wheat, barley, and oats, particularly in damp warm seasons, have sometimes their ears coated as if with soot, and which is mixed up with a sticky matter. It occurs just as the ears are appearing out of their sheaths. It generally only attacks a very few grains in an ear. It seems a disease of nutrition; but a fungus, the *uredo segetum*, grows in it, and is often, but apparently quite erroneously, put down as the cause of the disease.

4. *Sedging. A disease in oats, in which the leaves become hard, the root enlarged, and the whole plant stunted.*

This affection would seem to be caused by an excess of water about the roots, which, by diluting to excess the food, interferes with their nutrition. "I have cured," says Mr Stephens, "a piece of land of its constant tendency to grow sedged oats simply by draining."*

5. *Consumption. A disease in which the whole plant begins to decline, and ultimately to shrink up and die.*

This is perhaps generally the termination of some of the diseases of nutrition, but it sometimes occurs idiopathically, or, at any rate, without the precedence of any known disease. It certainly seems to be occasionally caused by excessive flowering. What has been called the tenedo in pines seems a form of this affection, probably induced by a long-continued deficiency of nutriment.

6. *Anbury. A disease of turnips, in which an excrescence grows underneath the bulb, and takes away all the nourishment that should form the bulb.*

Eventually the excrescence becomes putrid, and the whole plant dies. When turnips are affected with this disease, the tops become yellow, and flag in the heat of the sun, and in this manner the presence of the disease may be inferred. Insects are found in the diseased structure, but they are certainly there in consequence of the disease, and not as a cause of it. "If," says Mr Stephens, "the disease were occasioned by the puncture of insects, better cultivation would not abate its virulence, but rather increase it, as the turnips would then be rendered much more palatable to them. The truth is, that all such diseases arise from poverty of the soil,"

* *Book of the Farm*, vol. i. p. 254.

and also from defective nutrition, "either from want of manure when the soil is naturally poor, or rendered effete by overcropping. Labour, clean, and manure the soil fully, according to the condition it presents, and no anbury will appear, unless it may happen in peculiar seasons, which always counteract the effects of culture, and affect plants in a manner similar to want of nutriment." *

7. *Club. A disease of brassicaceæ, in which the root enlarges, and the plant becomes sickly and puny.*

In this disease, in the cabbage, the root has several enlargements upon it, varying in diameter from half-an-inch to two inches. It generally occurs in old cultivated soil, in which cabbages have been too repeatedly planted. The cause of the disease is almost entirely an imperfect supply of food, the deficient ingredient being probably potassa. The cabbage is a most exhausting crop, and especially of this substance. Assuming that the yield of cabbage be 20 tons to the acre, the soil would require to furnish 900 lb.† of inorganic matter; and of this no less than 105 lb. would be potassa—likewise it would require 112 lb. of phosphoric acid, and 192 lb. of sulphuric acid. Even if ground be tolerably well manured for each crop of cabbage, we can understand that it would become deficient in some of these substances. Besides, in the larger varieties of cabbages, the crop is often more than twice as great as that now assumed.

8. *Fingers-and-Toes. A disease in turnips, in which the plant, instead of forming a bulb, sends out numerous stringy roots.*

This is a disease of nutrition, and has principally been observed on light soil that has frequently been cropped with turnips, and it has been banished from these soils by superior manuring. The disease comes on between the time of the singling and the first hoeing of the crop. The affected plant becomes flaccid, and its leaves become yellow. Commonly the disease breaks out in isolated parts, and thence extends, but irregularly, in patches; and then the peculiar substitute for a bulb is formed. A turnip thus affected has a tendency to seed prematurely; and, owing to the inequalities in the bulb, water is apt to lodge, which, if frost come, freezes, and causes premature decay. The texture of the finger-and-toe is fibrous and tough, and the diseased plant is acrid to the taste.

9. *Ulceration. A disease of stems and bulbous roots, attended by discharge of fluid, and ending in partial mortification.*

The word ulceration, as applied to a vegetable disease, is not proper, for an ulcer is produced by an excess of absorption over

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* *Book of the Farm*, vol. ii. p. 80. † *Johnston's Lectures*, p. 389.

deposition; and, as has been mentioned before, there is no evidence of the existence of any interstitial absorption in plants. The disease now noticed, however, looks like an ulcer, but the portion that shows the cavity does not do so from absorption, but from sloughing off of the part that has been affected. Mr M'Intosh* states the cause of the affection, where it occurs idiopathically, in *bulbs* to be cold or damp. The ulcer in *plants* is generally produced by internal violence, or from rain or snow stagnating on parts of them; but it also appears to occur idiopathically.

10. *Cancer. An apparently malignant disease of fruit trees, characterised by the growth of a spongy excrescence, that gives out an acrid discharge, and never spontaneously ends favourably.*

This disease is not a true cancer if it do not contain matter not found in a healthy plant; and this, as far as we are aware, has never been detected; but it seems probable that if proper inquiry were made, some such would be found. At least the incurability of the disease would, from analogy with similar diseases of animals, seem to indicate its nature.

11. *Moist Gangrene. A disease of fruits, flower-roots, and leaves, attended by a foul discharge, ending in a moist gangrene, and believed to be more or less contagious.*

This disease commences by a number of green spots of various sizes, which soon enlarge and darken. "A swelling," says Professor Balfour,† "first takes place, and then, on contraction, the epidermis bursts, and a dark fluid oozes out having a fetid odour. The disease goes on increasing until complete disorganisation takes place; the diseased cells are found to contain dark granules, sometimes also a vibrio has been detected. The disease is produced by cold and moisture."

12. *Dry Rot. A disease of trees, particularly of the larch, in which the albuminous parts of the wood are affected and destroyed, and the trunk in consequence crumbles away.*

This disease is now well understood, and it affords an instance of the benefit of investigating causes. Although cherry-trees are liable to it, it has been principally observed in timber. It is caused by albuminous matter acting catalytically on the lignine, and causing it to rot. In dead-wood trees, or rather in wood that has not long been cut down, the process may be stopped by adding to it any deoxidising substance, as corrosive sublimate, blue stone, which may combine with the albumen, and render it insoluble; this is called popularly, from the name of a patentee regarding it, Kyanising. In the present state of our knowledge,

* *Book of the Garden*, vol. ii. p. 701.

† *Class-Book of Botany*, p. 696.

however, we do not know how to apply any of these substances to a tree uncut down, and unquestionably alive.

13. *Monstrosities. Morbid non-malignant growths, of which the most important are—*

a. Deformed flowers, which are thereby generally rendered unfit for reproduction.—The most usual instances of this are absence of stamens or pistils, or both. This monstrosity is generally produced by too luxuriant a culture. An example of this may be found in the snowball (*Viburnum opulous*). As growing in our gardens, the flowers grow into large rotate, or corollas that have neither stamens nor pistils. In its natural state, the shrub has small campanulate flowers, without stamens or pistils, and the flowers are about three times as large as in the natural state.

b. Tumours on the wood and bark.

c. Warts on fruits.

d. Bedeguar, which perhaps, however, only occurs in roses.

The two first of these are provisions of nutrition, of common occurrence—the warts, however, having been principally noticed on apple-trees. The bedeguar has not been much investigated, and perhaps has some connection with insects.

14. *Lepra. A bark disease. It is extremely probable that there are a great many bark diseases.*

The one called lepra (if indeed it do not include many diseases) is a diseased state of nutrition in the bark, in which the outer surface dies, and affords a seed-bed, or rather a spore-bed, for cryptogamic parasites.

Section XII.—Chronic Diseases produced by Parasitical Plants and Animals.

See the general question examined in paragraph 12. Previous numbers of this Journal contain a very full account of the insects that are injurious to agriculture; and we hope in the next number to enumerate and state the plants preferred by parasitical plants, and the various parasites found on different vegetables.

Section XIII.—Surgical Diseases.

1. *Wounds. A solution of continuity from violence.*
2. *Fractures. Separation of stem or branch into one or more pieces.*
3. *Stroke by lightning.*

These three diseases have been incidentally noticed in previous paragraphs, at as great a length as seems proper in this outline.

SECTION XIV.—OUTLINE OF PRINCIPLES OF VEGETABLE THERAPEUTICS.

The only philosophical plan of treating vegetable disease consists in endeavouring to decide in what manner the fatal termination or death is likely to be induced (see paragraph III.), and then, in either taking measures to bring about a state of the system of the diseased plant contrary to such a tendency, or in removing the plant from the causes of disease. If the potato-blight, for instance, is caused by a deficient supply of potassa, then it is plain that potatoes only should be planted in land that has a due supply of potassa, in a form so soluble that it can be afforded to that season's potato crop. If the unsuitability of the soil induce more chronic disease, as if damp induce lodging in oats, or in many other cases, we may naturally hope to get rid of the malady by draining, and many other analogous instances will present themselves to the reader of the preceding pages. But when a disease has once formed, it becomes a very important question,—is there a system of therapeutics that can naturally direct us to a plan of treatment,—to the administration of drugs, to the employment of surgical remedies, &c.? The answer is, that beyond a few external applications, there is not at present; but there is no reason why there should not be. Human medicine was once in the very same condition: "Quos tamen Homerus," said Celsus, in speaking of the two sons of Esculapius, "non in pestilentia, neque in variis generibus morborum aliquid attulisse auxilii, sed vulneribus tantummodo ferro et medicamentis mederi solitos esse proposuit. Ex quo apparet has partes medicinæ solas ab his esse tentatas, easque esse vetustissimas." *

ADDITIONAL NOTES ON THE PRESERVATION AND DRYING OF GRAIN.

By R. S. BURN, Engineer.

IN a former paper† on this subject we described pretty fully the advantages which result from the practice of preserving grain from moisture, and endeavoured to analyse the process of kiln-drying, as ordinarily conducted, with a view to show the defects attendant upon the process. In a subsequent paper‡ we offered some remarks as to the preservation of grain, so as to retain its dryness—the desiccation being effected previous to its being stored away. From the limited space at our disposal on the occasions above alluded to, we were prevented from going so fully into the

* *De Re Medica*, lib. i.

† *Journal of Agriculture*, No. XLIV. p. 345.

‡ Ibid. No. XLV. p. 429.

matter as we deem its importance requires. It is the object of the present remarks to effect this presumed desideratum.

So long as the present system is adopted of storing grain in the sheaf, not in bulk, it is evidently a matter of great importance to facilitate the housing of the sheaves. It has often occurred to us that the arrangements for effecting this are too dependent upon manual labour to possess that capability of extension, both as regards power and quickness of operation, which the exigencies of farm-work demand, and which, in this uncertain climate, would be so valuable in a pecuniary point of view. Every agriculturist knows the importance of speedy "winning" of his crops. To facilitate this, any appliances which would not involve too great a cost in their construction, would be peculiarly valuable, and would soon repay themselves. Speedy winning may be effected by adopting two plans, one of which has for its object the performance of the drying effect, which, under the present system, genial weather alone can give—the other, the quickly removing the corn so dried or prepared to the place in which it is to be stacked or stored. To gain complete efficiency, the two must be worked in conjunction, as it is evident that there is no use in making arrangements to prepare corn for stacking or storing, and leaving it so prepared to the chances of being again deteriorated, in consequence of having no easily available means for quickly removing it.

The drying of corn in the field is likely to be characterised by many as a refinement in agriculture not probably to be soon realised in practice. There are not a few processes which are now part and parcel of a good system of agriculture, which, by men now departed, and possibly by some still living, were and are characterised as refinements in practice, and the day-dreams of theorists. All innovations meet generally with this reception. A traveller in that land of wonders, China, saw a man carrying a chest of tea, which dangled from the end of a pole resting on his shoulder. To effect a balance, John Chinaman, with a due knowledge of the principle of the lever, if not of animal mechanics, had attached a huge stone at the other end of the pole. The traveller, very naturally concluding that all the advantages of this ingenious arrangement might be retained, with others not evidently contemplated by the trudging porter, suggested it might be better — that if, instead of a stone, he placed a second chest of tea, thus carrying two at once. With stolid gravity, and a look of pity at the man who could counsel so, the porter answered, "Our fathers did as I do now; are we wiser than our fathers?" Of course, not contemplating such an appeal to the principles of filial reverence, the traveller found this answer unanswerable. So with this as with many other proposed agricultural innovations, those to whom they are presented, in the spirit if not the words of the honest Chinaman, meet them with a "Those who went before us, honest men! stood

the chance of rainy days and heated corn, and so will we. Are we wiser than our fathers?" But *rêvenons nous à nos moutons*—to "return to our mutton," or our *corn*.

The advantages of attaining a proper condition of dryness in the corn with celerity, and a considerable degree of certainty, both as regards the time consumed in doing it, and the degree of dryness effected, are so very obvious, we think, that it is unnecessary to detail them. The importance, also, of trusting as little as possible to the chances of our proverbially variable climate has been so emphatically and repeatedly endorsed by authorities whose experience there can be no gainsaying, that we need not apologise for throwing out a few suggestions as to the best method of avoiding this "trusting to contingencies."

Many of our readers are aware that the plan which has been made most widely known, is that in which a chamber is used, in which the grain is placed in layers on a series of racks or open shelves. It is quite obvious, however, that the process, as thus carried out, will both be uncertain as to effect, and slow and tedious as to time. Many of the objections which we offered to the system of drying grain by means of the ordinary floor-kiln apply equally to this. However large may be the quantity of air, heated or otherwise, which is forced into the chamber, and which, in passing through the grain, is to carry off its moisture, a large percentage of the material will have no contact with the evaporating current. As in corn-drying, the "standard of perfection" which we pointed out in our paper in No. XLIV., namely, that "each individual grain" shall in its turn, and on all sides, be subjected to the heating medium,—so, in drying corn in the sheaf, the standard of perfection is, that the surface of each straw or ear shall be subjected to the heating medium. Of course there are difficulties in the way of drying corn in the straw which are not met with in the drying of the separate grain. The grain, from its very form, offers facilities for effecting the desideratum; but the same object in view in both cases—namely, the *individual separation* of the bodies or substances to be acted upon—is the only key to successful and speedy drying. Hence, as we showed in treating of drying corn in the grain, drying corn in the straw means, strictly speaking, the drying of each straw one by one, without reference whatever to the other straws or ears in bulk.

It has been said, that had it not been for the adaptation of *circular motion*, with all its capabilities of being altered in speed and direction, our varied manufactures would never have reached their present stage of perfection. Enter a mill, no matter whether the material operated upon be cotton, wool, silk, paper, or corn, the important processes are all sure to be effected by circular motion. This is the cheapest of all motions produced, and the most easily controlled; it possesses, moreover, not only a continuity, but a pre-

cision and regularity which is amazingly valuable. We have already shown how the "standard of perfection" in drying of *corn* was gradually approached, by leaving the processes which demanded *irregular motion*, and adopting those in which it was circular. The question then arises,—how can the regularity of transmission and facility of regulation as to speed be obtained while treating of such a material as grain in the straw? The solution is offered by the cotton "blower." In this machine the object to be effected is the presentation of the cotton in comparatively small quantities to the action of beating or revolving arms, so as to subject a certain length of fibre to so many blows or beats in a given time. The beaters revolving with a uniform speed, it is obvious that the cotton should be supplied to their action in undeviating quantity and regularity. Over two rollers an endless apron is stretched, this being composed of a series of thin and narrow stripes of wood fastened to two ribands or carriers which pass tightly over the rollers. A flexible apron is thus obtained, which can be moved along, and anything resting or placed thereupon, at regular and unvarying speed by simply imparting motion to one or other of the rollers. The cotton spread in this is gradually carried forward to a pair of small diameter rollers, which revolve nearly in contact. Revolving at a uniform speed, these take in and pass to their other side a quantity of cotton which is uniform in length and thickness; there is thus presented, in a certain space of time, a certain length or riband of fibre to the action of the revolving beater. Make the case receptacle in which the beater revolves a heated chamber; remove the revolving beater, and continue the endless apron through between the feeding-rollers to the other end of the chamber; make the apron of open network, galvanised iron or zinc; substitute hay or other crop for the cotton,—and you have a drying apparatus, the regularity of motion of which is within easy command. To prevent all chance of the grain or crop being injured, the feeding-rollers may be dispensed with, and the thickness of the layer sent through the machine regulated by hand. With the crop passing in at one end of the heating chamber and taken out at the other, a very limited range of drying would be attainable; a wider range can easily be obtained by increasing the number of revolving aprons, each of which revolves in a direction contrary to that of its neighbour. This arrangement would thus resemble the arrangement of Archimedean screws in the machine illustrated in No. XLIV., page 353; and in this way, by regulating the speed of the rollers, the crop could be subjected for any length of time to the action of the warm air. That some such plan as this would be thoroughly effectual in *all* cases there can be no doubt, but whether it would pay thus to adopt it is not our province to determine. Of this, however, we feel confident, that in the case of grain subjected to heavy and

continuous rain or damp weather, it would be attended with economical results to have such an apparatus, as part of the mechanism of the farm, ready for immediate use in such circumstances. Few harvests, indeed, pass without our farmers having on hand a considerable quantity of grain which would be made as valuable as any other portion of their crop, by being treated in the way we have described. But although we are not prepared to advocate the use of such an apparatus, with its movable apron and heated air, as a paying one under all circumstances of place and weather in our climate, we do not extend the same uncertainty of decision with reference to the plan of individual separation of the straw, so far as this can be done with a moderate outlay of time. The practice of tying up the grain into bundles or sheaves, and placing these again in a heap together, is certainly not the speediest way of attaining the end in view. To squeeze damp clothes together, and then huddle them together, is not the best way to get them dried, or else the practice of the honest washerwoman of spreading out as much of their surface as possible is an erroneous one. The eminent authority on agricultural matters, Mr Stephens, in his work, *The Book of the Farm*, notices, as one of the advantages of mowing crops in place of reaping them, that the crop is quicker ready for "winning." "Mown wheat," he says, "is ready for the stack in three to five days, and barley and oats in eight or ten, the chief cause of the difference being the loose and open state in which mowing places the straw, while the straw reaped by the sickle is much compressed in the lower part of the sheaf, which most requires exposure." The question here arises, if this fact alone gives to mowing corn such a "decided superiority" (we use the words of Mr Stephens) over reaping by the sickle, would it not be worth trying to increase the advantage so gained by extending this principle of giving to the straw "the loose and open state" which is thus shown to be so valuable? We think it is worth the trial. If it pays glue-makers to erect light and open framework to dry their cakes or sheets of glue, would it not pay the farmer to do the same to serve this office for his grain? Weight for weight, there is a great difference in the value of these substances, and all in favour of the grain. The planting of a few dozen iron rods with prongs or forks to stick into the ground, and the laying of some dozen yards of wire-netting, would be the work of a very short time, and a series of shelves of large superfices would thus be obtained in the field in which the mowing was going on. A light roof over the top shelf would finish the whole. The mechanical arrangements by which this suggestion could be carried out are so simple, and we think must be obvious to all after a moment's consideration, that it is not necessary to detail them; suffice it to say that a series of shelves or horizontal open frames could be supported one above the other by having a series of "shoulders" at an equal

height in the upright rods; each shoulder decreasing in diameter as it approached the upper end of the standards. The sheets of perforated wire would in this case have, at proper situations corresponding to the distances between the standards, holes or rings of diameter somewhat less than the shoulder on which it was designed to rest; these holes being of different sizes, and the sheets or shelves being numbered corresponding with that of the shoulder on which it was to rest. The standards being fastened in the ground, the sheet having the largest holes or rings would be passed over, the standards passing through the rings, and the shelves being prevented from slipping down the rod by resting on the shoulder. The sheets having the second size of rings would then be passed over the standards, and would rest upon the second size of shoulder. A series could thus be placed, all capable of supporting a considerable quantity of grain opened out in comparatively thin layers. The straw thus placed would dry rapidly; from rain showers descending in such a way as not easily to get between the shelves placed thus, and exposed to such thorough and continuous currents, there would be little chance of having heated corn. We have already noted the importance of having a ready means of removing the grain in straw to the place where it is to be stored up. Previous to briefly going into this point, it is right to state that Mr Saunders of Staines has recently patented a plan of drying grass and other crops by a process almost identical with the one we have described. In the specification which has been laid before our notice within the last week, he fully describes the means by which it is effected. In addition to the plan of moving aprons, he proposes another, consisting of a revolving wheel, cylinder, or cage, made of wire-cloth or open work, placed within a heated chamber, and divided by a series of radial partitions into compartments. By the revolution of the wheel the hay is shaken or tossed to and fro within the chamber, and thus nearly every part is subjected to the action of the heat. It is obvious that this plan, however efficient for hay, would not answer for cereal crops. The turning about in the chambers would possibly bring about a result too much akin to that of threshing to be desirable. The method by which Mr Saunders carries out the principle of moving aprons is very ingenious. The size of the heating chamber which he has found convenient is 6 feet wide, 10 long, and 12 high; the temperature of the warmed air being 100° to 120° Fahr. The rollers on which the aprons move are about 4 inches diameter, and the distance between each apron is about 8 or 10 inches. The upper apron is partly exterior and partly interior with reference to the heating chamber. The apron passes in through an opening in one end of the chamber at the top, and through a similar opening at the bottom. The hay or other crop is fed to the apron at the top in as equable a layer as possible. It is carried into the chamber; and on approaching

the end, at a distance of 20 inches therefrom it is dropped upon the apron immediately below, which, moving in an opposite direction, conveys the material to the other end of the chamber; at a distance of 20 inches from the end it falls from the second to the third apron, and so on until it is delivered through the opening in the end at the bottom of the chamber. The heating chamber should be provided with a ventilator, through which the heated moisture should pass to the atmosphere. The efficiency of the apparatus will be increased by having a current of air blown through it by means of a fan.

We now return to the consideration of a ready means of removing the crop, and of storing the same. The plan of sticking a pronged fork into a sheaf of corn, and carrying it hoisted thereon to a cart or stack, possesses at least the advantages which may be supposed to emanate from a practice which can boast of high antiquity. Little more can be said in its favour. It is a plan which is prodigal of animal strength; the operative has not only the weight of the sheaf to support, but he has to expend a considerable portion of his strength in preventing the reared-up sheaf from toppling over. This to a strong man may be so small in amount as altogether to be unnoticed; but a continual repetition of such efforts, however slight, tells at the end of a long day's work. Mr Stephens wisely counsels that, in building a stack of corn, "it should be studied to let the ploughman have the advantage of any wind going in forking the sheaves from the cart." Were this forgotten, not only might the wind blow over the upreared corn, but the corn-lifter. Could not the process be carried on without "wooing the wind" thus? Let us inquire. Suppose a frame running upon wheels, having at one end a joint, attached to which is a long frame, somewhat in appearance like a common ladder. At the opposite end of the travelling frame place a vertical standard, supporting a worm-wheel, which works into the teeth of a pinion fixed on a shaft of a large toothed wheel. To about the middle of the jointed frame or ladder attach firmly a cast-iron segmental rack, in the teeth of which works the large toothed wheel, actuated by the horizontal worm-wheel. At the foot of the jointed ladder, and at its further extremity, place a pulley, and round it an endless belt, furnished with projecting prongs or tines. By appropriate means, with either manual labour or steam power, cause the pulley to revolve; place a few sheaves on the endless belt, and to take them up the inclined plane to the level of the stack is the work of a few seconds, and of exceedingly little labour. As the stack increases in height, work by means of its handle the horizontal worm-wheel; this causes the toothed wheel to raise the segmental rack attached to the jointed frame; and thus by simple means the sheaves can be taken up to any elevation. Such, with modifications and arrangements, which it is not necessary further to describe, is the mechanism for raising

and stacking hay, invented and patented by Mr James Hayes of Huntingdon. The principle is evidently susceptible of numerous modifications more or less simple in their nature. Similar in arrangement is the stacking machinery of Mr Joseph Bench of Craig Hall, in Macclesfield. He applies it also to the loading of waggons, the frame being "attached to and dragged at the cart or waggon's tail, motion being given to the raising-cloth (or endless apron) by wheels in contact with the ground." In either case, whether for stack or waggon loading, Mr Bench recommends them as substitutes "for the laborious work of pitching," which will "prevent the loss which frequently occurs by shaking and knocking the produce about during the processes of stacking and storing." We think it evident that much may be gained in many ways by using easily-regulated mechanism for laborious manual operations. Simpler contrivances than those suggested could easily be devised. Having now got the corn in sheaf stacked, is there any way of securing its preservation while there? We may put it in dry, but can we keep it so?—or we may put it in only partially dry, can we make it, while there, wholly or nearly so?—or we may put in a portion damp or wet, can we prevent this from influencing the portion that is already sound? These are questions the answer to which will involve some details that may be considered interesting as well as useful. We shall direct our attention in the mean time to the last of these.

It has always appeared to us an interesting problem, whether there could be some means devised for preventing the spread of disease or unsoundness in collections of grain, without involving either much manual labour or expensive constructions. The patent granted to Edward Loradoux Bellford, 16 Castle Street, Holborn, London, professes to give a solution of this problem. The means by which he does so are exceedingly simple, and are based on the following theory: "In vegetable substances which contain only a small quantity of moisture, the process of decay always or almost invariably commences at the centre of a mass, and from thence extends in all directions. It is well known to millers and others engaged in the manufacture, storage, or transportation of flour, meal, and grain, that in those substances such is the case, the centre being frequently found soured and heated highly, while those portions near the outside of the mass are uninjured. It is also the case in hay or other substances of a similar nature." Such, then, is the theory; the practical method of obviating the evil deduced from thence is very simple. Take out the centre mass, or insert a tube or series of tubes in the centre of the receptacle in which the flour, &c. is contained, and the difficulty is met. What the consequence of this simple contrivance is, a brief investigation will show. Suppose a barrel of dry sponges, having in the centre thereof a series of sponges saturated with moisture extending from

top to bottom of the barrel, there will thus be a core of wet in the midst of the dry sponges. According to the theory above noted, the wet will radiate from the centre mass outwards in all directions, and the surrounding mass will become gradually saturated. As there is no obstacle in any one direction to these radiations of wet, we can suppose the process to go on by adding a series of concentric rings of wet sponge to the primary central mass, these rings of wet progressing towards the external barrel. It is not at all likely that the wet will progress only on one side of the wet central mass, thus forming one semicircle of wet and another semicircle of dry sponge—it is just as natural for the wet to go to one side as to the other; and seeing that there are no obstacles to its doing so, the almost absolute certainty is that it will go to all sides. In the centre of the barrel place a tube; the consequence is, that the wet mass is displaced to one side only, and before the damp or unsoundness can reach to the opposite side of the tube and the material there placed, it *must* perforce travel round the whole circumference of the tube. But to travel in this way the wet must progress in a lateral direction, and we have already shown that it radiates from a point like the spokes of a wheel; its progress, therefore, will be mainly outward towards the barrel. By this arrangement, therefore, only a minimum portion of the mass is damped, and the chances are that before all the mass round the central tube gets damp—which must necessarily be a slow process, as each damp portion will only, like its neighbour, radiate from its centre—the flour or grain will be dislodged from the receptacle. Without the central tube any wet mass is free to radiate in all directions; with the tube, a large proportion of these rays are arrested by the tube; and these, left free to go amongst the mass, penetrate only in the line of the thinnest portion. Were damp or wet the only evil to be arrested, it would not be so important a matter to prevent it, as, on the supposition that only a small portion was admitted damp, by communicating itself to others it would be so divided that in each it would be almost inappreciable. But wet brings decay, and decay "grows by what it feeds on:" it progresses steadily to a consummation. It may be compared to gangrene in the animal body; it must be lopped off, got rid of—cannot be brought to a healthy state itself, it must only be prevented from contaminating the surrounding portions. The invention, when applied to barrels for transportation, is more particularly meant for Indian-corn meal and wheat flour. The following are some data which may serve as guides to parties using the plan. For a barrel of wheat flour of the usual size, containing about 196 pounds, for a voyage of about a month or six weeks, a tube of 2 inches will be sufficient, and one of 2½ inches for a six months' voyage. As, however, Indian-corn meal is much more liable to decay than wheat flour, it is desirable that a tube of 7

inches diameter for a six months', and one of 5 inches for a six weeks' voyage be provided.

The plan is also applicable to corn-bins and corn-stacks. In the latter the central opening is recommended to be made by means of poles, an opening being made at top and bottom of the central tube to admit of ventilation.

Whether the theory on which the plan is based is correct or not, there can be no doubt that the spread of decay in a mass of flour, &c. will be materially prevented by the placing of a tube or cylindrical body in its centre; even although the decay does not progress radically as suggested, the effects of contact will be materially lessened. But as to the great advantages attendant upon the plan, when made subservient to another purpose, there can be no doubt.

In the year 1743, Dr Stephen Hales published a work, in which he described his ventilating machines, and detailed their advantages for a variety of purposes,—amongst others, he endeavoured to prove their "great usefulness in preserving all sorts of grain dry and sweet, and free from being destroyed by weevils both in granaries and ships, and also in drying corn, malt, hops, &c." That his plan was not chimerical appears from contemporary evidence of its usefulness for these purposes. It consisted in forcing a quantity of air through the mass of grain, flour, &c. by means of his ventilators. It is unnecessary to describe how these are constructed, as the comparatively clumsy machine is now entirely superseded by the efficient fanners of the present day. It is, however, singular to notice that the other part of his plan presents a great similarity to that just described. Dr Hales carried a tube through the centre of the mass, all the difference being that it was perforated with holes, to admit the air which was forced into it to the surrounding mass. It appears that this plan was held in high esteem by the farmers of the day. A hollow reed or cane perforated with two hundred holes was placed in the centre of the sack, and a common bellows being attached to the tube by a leathern pipe, a quantity of air was forced into the tube. The plan was also adopted in France; for it appears from a statement in the *Gentleman's Magazine* that M. de Humel de Monceau, a member of the Royal Academy of Sciences, "preserved a large heap of corn free from weevils for two years without turning, by merely blowing air through it." This principle of forcing air through masses of material to be preserved or dried is undoubtedly a very valuable one, and deserves the attention of all agriculturists. The means by which its advantages can be obtained are so simple and inexpensive that they cannot or should not stand in the way of realising these advantages. We have no doubt whatever, from what we know of the astonishing power of currents of air, that it would pay, in every sense of the word, to provide a central opening

to all stacks of every crop, and to force into—not through—these tubes a large quantity of air by means of a hand fan; or, still better, to work the fan by steam, and force the air through pipes leading through a steam chest, or the upper part of a boiler, thus obtaining warmth and dry air. The outside of the pipes being surrounded with steam, the air forced through them, in its way from the fanners to the stack would be soon raised to a sufficiently high temperature. But even where the plan of forcing air into the central openings in the stacks was not adopted, considerable advantage would still be gained from the opening or central tube alone. All that would be necessary in this case would be to have it, if solid, well perforated with apertures, and a free opening at top and bottom. To get the latter, the stack would require to be raised from the ground: this, however, is done in all cases of improved stack construction.

As evidence of the extraordinary desiccating or drying powers of currents of heated air passed through or in contact with various materials, we may here give some interesting results, for which we are indebted to the patentees of the Improved Desiccating Process, Messrs Davison and Symington. The principle on which it is conducted is simply forcing large bodies of air through a series of arched pipes heated by an ordinary furnace, and passing this at a high temperature into the chamber containing the materials to be dried. The air is forced through the pipes by means of a fan. The process has been applied to the drying of almost every species of material, the value of which is increased by being in a thoroughly dried condition. We shall here give a few facts connected with the process as applied to the drying of wood, from which may be deduced its value for the purposes of the agriculturist: "A saw-maker of well-known reputation in London sent to be seasoned a piece of inch-beech, of which saw-handles are made, and which he could vouch for having been in his possession for twelve years, and during four years of the twelve it had been lying in the tie-beams of a roof immediately over a smith's forge. From its appearance and sound this wood would have been pronounced thoroughly dry, yet, after being exposed to a current of heated air, at a temperature of 240°, for about two days, it lost 11 per cent of its weight." This may be cited not only as a proof of the difficulty there is, under ordinary circumstances, in freeing wood from moisture, but also of the extraordinary drying powers of heated currents. Another case may be interesting. A violin which had been in the possession of a person for sixteen years (how old it was when he first had it is not known); upon being exposed to this process, it lost in eight hours no less than 5.6, or $5\frac{3}{5}$ per cent nearly. It must be here noted that the effect of currents of heated air is vastly different from that resulting from exposing the substance or material to an equal temperature in an

oven or kiln. In the latter, the material is baked, and its fibres destroyed; by the former, the timber is positively strengthened. From a series of elaborate experiments, it was proved that fir, by being subjected to the drying process, had nearly 9 per cent added to its strength; elm, 12.3 per cent; ash, 44.7; beech, 61.9; and oak, 26.1. We give these details in connection with drying by heated currents, to show the value of this or a similar process when applied to grain. There seems to be an agreement on all sides, that a drying apparatus of a good construction, forming a part of the permanent mechanism of the farm, would soon pay the cost of its construction by the increased value given to various crops by its use.

Our space being now exhausted, we must lay aside the further consideration of our subject till another opportunity. As it is our desire to collect together as many hints and suggestions offering to be practical as possible, we may again shortly present our readers with another paper. Meanwhile we shall lose no opportunity of adding to our store of facts, either by the jotting down notes of modern practice, or ransacking the records of past experience, which will doubtless well repay the labour we give to it by the value of the knowledge it will yield.

COMPETITION OF REAPING-MACHINES IN FRANCE.

Perhaps no part of the Industrial Exhibition of 1851 attracted more attention, none certainly was observed with more interest and anxiety by agriculturists, than that corner of the American department in which were placed the reaping-machines. Just beginning to be relieved from those difficulties into which they had been thrown by the fiscal regulations passed a few years before, by which their labour was brought into competition with that of the serfs of Russia, and their produce with the contents of the overflowing granaries of the world, and thrown entirely upon their own resources, the farmers of Britain, with that indomitable perseverance for which they have always been distinguished, were anxiously applying to practice the suggestions of science, and calling in the aid of machinery to those of their operations where it was at all practicable. Nor should we forget that the draining away to the United States and the colonies of that part of the population on which they were mainly dependent for the reaping of their crops, excited no little alarm at the time, and stimulated both farmers and mechanicians to try and find a substitute—a reaping-machine for the Highland and Irish reapers.

Strange it was that in such circumstances the interest of the farmers was not sooner excited, and their attention drawn to the fact that, many years ago, premiums had been awarded for the best reaping-machines by the Highland and other agricultural societies—that there were models to be seen of them in all our agricultural museums, and that one had been in use for years in Scotland. It was not till successful trials had been made with those exhibited in 1851, and their merits lauded by all and sundry, and people regarded them as ingenious, useful, and original pieces of machinery, that the agricultural community in Scotland recollected that the principle of the successful machine was the same as that of one of the models in their museums, and a slight modification of the machine which had been constantly at work for years in this country. Inquiries were then made, and no doubt was left in the minds of any that the Scotch machine invented by Mr Bell was the original of the reaping-machines made in America, and exhibited in London in 1851.

Nor has the spirit of invention been allowed to flag since then. In that year only two machines, from the same country, competed for the Exhibition honours; this year, no fewer than nine, from three different countries, exhibited their peculiar excellences on the fields of France. As at the London Exhibition, the agricultural implements entered for competition at Paris were subjected to a trial on the farm of Trappes, occupied by the proprietor, M. Dailly. The first trial of the reaping-machines took place on the 2d of August, the second on the 14th, in the presence of Prince Napoleon and a large number of most distinguished individuals from all quarters of the globe. The most lively interest was manifested in the trial by all classes, so that an immense crowd resorted to Trappes to witness it; but many were doomed to disappointment, for the ground was most sedulously guarded by soldiers, so that but few had an opportunity of examining the machines, and the work done by them. M. Barral, one of the jury, had principally to do with the arrangements for the trial; and we observe the names of Mr Wilson, Professor of Agriculture in Edinburgh, Mr Fairbairn, Engineer, Manchester, and Mr Edward Combes, C.E., as representatives from this country, and officially connected with the proceedings.

At the first trial of the machines they were divided into three groups. The first comprehended the machines of M.M. Cournier and Laurent in France, and of Mr Atkin from the United States. The reaper of M. Cournier is very light in the construction, and is drawn by one horse; instead of the usual cutters, double shears are used, which are attached by means of a screw, and can be used at either extremity as required. A man seated behind directs the machine, and, by pulling a rod, causes a rake with three teeth to work in grooves, which removes the cut grain from the machine.

It cut about 1947 square yards of oats in forty-seven minutes; but as only one horse was used, it may be said, as compared with those machines which required two horses, to have done its work in from twenty-three to twenty-four minutes. M. Laurent's machine is on the principle of Bell's, being drawn by two horses behind, and had three men directing the horses and the machine. It would appear from the report that an unfavourable impression was produced against the horses being yoked behind, from this machine not being able to finish a part of its lot, which was separated from the rest by a gaw-furrow 7 inches wide, till the gaw-furrow was filled up. Mr Atkin's machine is called the Automaton Reaper, from a self-acting contrivance being substituted behind for the man, who removes the corn as it is cut. One man is thus sufficient for the machine, which is also pushed by two horses behind. It cut 2072 square yards in twenty-four minutes, and was sold for about £40 sterling.

The second group of machines was composed of those of M.M. Mozière in France, Manny from America, and Crosskill from England. Mozière's machine is drawn by one horse in front, and possesses the peculiar advantage over all those with the horses in front, of cutting, and throwing the corn when cut, either to the right or left, so that much manual labour is saved in cutting roads for it through the standing crop. Manny's machine requires two horses yoked in front. It does not appear to possess any peculiar advantage worthy of notice. A man is required behind to throw off the cut grain. It reaped 2272 square yards in twenty-three minutes. An accident occurred to Crosskill's Bell's at the start, and as it could not be repaired on the spot, the machine was withdrawn from the competition.

In the third group were comprehended the machines of M'Cormick, Hussey made by Dray, and Muddy from Canada. The great success which has attended M'Cormick's machine made it an object of attraction on the day of the exhibition. It is said, that since it was invented, 5225 of them have been sold, and that in this year alone 2500 have been disposed of. The machine is too well known to most of our readers to require any description of it here. It is considered a very happy simplification of Bell's. Of all the machines which were at the trial on the 2d of August, it accomplished its work in the shortest time, having reaped 2376 square yards in seventeen minutes. The announcement of this feat was received by the crowd with loud and protracted cheers. In the *Journal d'Agriculture Pratique*, to which we are indebted for many of the facts stated here, and whose editor, M. Barral, had the superintendence of the competition, the following comparison is made between the expense of machine and hand reaping. According to the rate at which M'Cormick's machine cut down its portion of the crop, it is found that 2.47 acres may be reaped in 1

hour 25 minutes. Making every allowance for the striving that would naturally take place among the men, and the ardour of the horses on a day of competition, as well as the short time they were engaged at the work, thus enabling the machine to do its work in a shorter time, we are perfectly safe, the writer in the *Journal d'Agriculture* thinks, in assuming that, under ordinary circumstances, the machine would cut 2.47 acres in 2 hours, working the whole day. Now, the usual rate of mowing a crop of oats at Trappes is 14s. 3d. for every 2.47 acres; that is, 71s. 3d. for 12.35 acres cut down in a day of 10 hours. The expense of reaping 12.35 acres with the machine will be as follows:—

	s.	d.
A man and two horses, ...	6	4
A man to throw off the cut grain, ...	3	11½
Four women to gather up the grain out of the way of the machine, at 1s. 7d. each, . . .	6	4
	16	7½

It will thus be seen that an ample margin will be left of gain to the owner of the machine, after an addition be made for repairs, tear and wear, and interest on the price of the machine, which is about £30. The above figures are merely converted from the French prices and measures, as detailed in the *Journal d'Agriculture*. Hussey's machine, modified by Dray, is drawn by two horses in front, is very simple and small, and so constructed as to pass by any road. It cut 2698 square yards in 34 minutes.

The second trial of those machines which were most successful on the 2d of August, was ordered to take place on the 14th of the same month by Prince Napoleon, the President of the Imperial Commission of the Exhibition of all Nations. A great agricultural fête was accordingly held at Trappes on that day, when all the machines connected with agriculture entered for competition were subjected to trial. Greater interest was felt in the proceedings than even on the former occasion; and when the immense crowd was assembled, and the machines set to work, from the splendid preparations made for the fête, and the mixture of military uniforms with the crowd (the grounds being guarded with soldiers), the farm presented a gay and stirring scene.

The field of wheat selected for the trial of the machines was divided into 7 lots of 1.188 roods each. The six machines of M'Cormick, Cournier, Wright, Manny, Dray, and Burgess, and 6 men with scythes, were chosen to reap the crop. M'Cormick's machine performed its task in 12 minutes, Manny's in 15 minutes, Wright's in 18, Cournier's, drawn by one horse, in 19. The six mowers, followed by six women to make the sheaves, took 25 minutes to finish their lot. The machines were then taken to a field of lucerne, where a new adjustment of the parts was necessary for cutting the different crop, in doing which Manny's machine required

but a minute, M'Cormick's 15 minutes, and Wright's 25 minutes. Cournier's was not constructed for reaping the crop. The portion of ground allotted to each was 1.386 roods, which was reaped by Manny's machine in 15 minutes, by M'Cormick's in 19, by Wright's in 20, and by the six mowers in 19 minutes. We may state, however, that the working of the machines was very much impeded by the trial of the rakes which followed immediately after them, scattering the lucerne as it was cut. The Exhibition medal, we believe, has been adjudged to M'Cormick's machine.

In concluding this notice, we cannot but allude to the fatality which has attended Bell's reaper in connection with the London and Paris Exhibitions. An unfortunate oversight prevented its being sent up to the former, and an untoward accident prevented its competing at the latter. This is the more to be regretted, as, being considered the original from which most of the other machines have been copied since 1830, we should have liked it to have had a fair chance of gaining those honours to which it is justly entitled. There is no doubt that it is yet far from perfection,—its high price, and the severe horse-labour it requires, rendering many farmers reluctant to purchase it. In looking back to the different trials of machines that have taken place since 1851, we are somewhat staggered at the conflicting decisions. The exhibitions which have taken place under the auspices of the Highland and Agricultural Society, have been marked by the preference which has always been given by the judges to Bell's, while the English Society has just as invariably awarded to a different machine every year—different both in construction and in principle. It is plain that neither mechanics nor the public can have any confidence in such decisions, which tend rather to retard than extend the use of reapers. The success of any machine depends much on the skilful management of the man who works it. From a report we lately saw of the trial of reaping-machines in a district of the Lothians, we understand that the premium was awarded to one of Crosskill's Bell's original reapers, and the man who managed it, in preference to all the others on which all recent improvements have been made. And farmers and societies in those districts where there are several machines, would do well to take the hint thrown out by the Secretary of the Highland Society, and award premiums to the best reaping-machine workers as well as to the best ploughmen; and we have no doubt that the Society would follow up the hint of its Secretary, and award one of its medals to the successful competitor.

UNIVERSAL ELECTRICITY.

By JOHN TOWERS, M.R.A.S., Croydon.

I APPROACH this subject with diffidence, in the firm conviction that, while I believe this agent to be everywhere predominant, I am constrained to acknowledge, with Dr Faraday, that we all remain profoundly ignorant of its nature. As an agent in vegetable growth, and in all the operations of agriculture, whether above or beneath the surface of the ground, it is invariably present, and performs its allotted work, equally in the fall of the silent dew upon the tender blade of grass, as in terrific rage of a violent thunder-storm.

More than twenty years have now elapsed since I perused the following remarkable extract from a lecture delivered by the late Professor Playfair: "If we consider how many different laws seem to regulate the action of impulse, cohesion, elasticity, chemical affinity, crystallisation, heat, light, magnetism, electricity, galvanism,—the existence of a principle more general than these, and connecting them all with gravitation, appears highly probable." The conjecture so expressed led to the conclusion that one great governing principle did in reality exist, as the fountain and source of every physical agency in nature. With this conviction, I regarded the sun itself—the centre of our solar system—as the sole great principle, whether he be a solid luminous body, or one surrounded by a luminous atmosphere, comprising the elements of light, electricity, magnetism, and actual heat, or that subtle matter so long retained under the mysterious term caloric, or latent heat. Be that so or otherwise, these emanations, or secondary elements, reach the earth in beams or rays which yield direct evidence that they comprise electrising and calorific principles, which, acting in or upon an appropriate medium, produce and develop electricity and sensible heat—phenomena which instruments not only reveal, but measure. Among the most powerful media of attraction and conduction are vegetable organised beings—trees, shrubs, and herbs of every description; and such, therefore, must be assumed as objects most interesting to agriculturists.

Plants abound with pointed terminations, and those are known to rank among the best and readiest conductors; hence we may safely infer that they perform an important *rôle*, as the media of reciprocating influence between the electricities of the atmosphere and the ground. Having thus introduced my subject by tracing all the great meteorological agents to their one prime source, it will, I trust, be manifest that no attempt will be made to introduce the science of electricity as dependent upon the experiments performed by lecturers and other scientific persons with statical electrical machines. These are curious, and to a certain extent

instructive; but they do not tend to interpret, or even explore, the profound depths of those mysterious agents which are combined with every particle of matter, solid, fluid, or gaseous.

More than a fourth of a century has elapsed since, in perusing a number of the *Mechanics' Register*, I met with a letter, under the initials of T. P., so remarkably comprehensive of facts bearing upon the relation between electricity and vegetation, that I feel it my duty to extract largely from it; for the subject has but too often been slurred over, as one little worthy of serious attention or confidence. The reader will now perceive that, after a lapse of twenty-seven years, few cultivators of the present day evince an insight so penetrating as did the nameless writer of 1827.

As his leading principle, the writer asserts that "vegetation continually extracts electric effluvium from the atmosphere, which is constantly, though in degrees materially differing, in a state of positive electricity; that the structures of vegetables and their juices are adapted to act with the greatest efficacy in imbibing the effluvium; and that it is highly probable that they are indebted to its influence for their vitality. These conclusions are strongly favoured by the positive electricity of the atmosphere, and that pointed conductors are peculiarly fitted for drawing off electricity in an almost imperceptible manner. Vegetables abound in pointed terminations, communicating with juices passing through capillary tubes possessing strong conducting virtues. These facts lead to the inference that plants act continually upon the atmosphere. But this inference is practically confirmed by applying vegetable points to the cylinder or prime conductor of the electrical machine. Few facts, indeed, are regarded as more fully established than that metallic points are the most efficacious instruments in abstracting electricity. This conclusion can only be accounted for from the circumstance that the attention of philosophers seems not to have been directed to the action of living points; for, on applying a blade of fresh grass and a metallic point, either alternately or in conjunction, to the electrised cylinder or conductor, it will appear that the grass acts at a greater distance with more vigour than, and in preference to, the metal. The leaves of trees, and even their fine ramifications terminating in buds, and in general all the living pointed extremities, and the sharp and serrated edges of vegetation, will be found to possess the same energetic conducting qualities, in proportion to their vigour and the acuteness of their terminations. Even a thorn or a thistle will vie with, if not excel, the sharpest needle; and it may be observed that they are far better fitted to act upon atmospheric electricity, as the deposition of moisture consequent to the withdrawal of the effluvium which held it in the state of vapour, so far from diminishing their conducting virtues, as is the case of metals, is the very principle of their nutrition; so that there is reason to conclude that

the action of every point furnishes it at once with the means of its vitality, its growth, and maturation. A few blades of grass held towards the knob of a charged jar, the circuit being completed by the human body, will completely, but silently, effect its discharge without affecting the human frame."

This, by the by, is a remarkable circumstance, since every electrician knows that by completing the circuit between the knob and coating of a charged jar, by touching the coating with the finger of one hand and approaching the knob with a finger of the other—or again, by substituting a metal rod for the latter finger—a powerful shock will be given, the sensation of which is felt either at the two wrists, elbows, shoulders, or back and chest,—its force increasing in intensity just in proportion as it approaches the centre of the breast.

"The admirable adaptation of the atmosphere to a system of vegetable points, forcibly indicates their mutual utility and dependence. It constitutes a vast electrical apparatus, on which, in all probability, the existence of vegetation and the ordinary tranquillity of nature depend. Storms and hurricanes sometimes occur; but if, instead of the myriads of active vegetable points, extending to considerable heights, and acting with peculiar force near the earth's surface, no vegetation existed, and the electricity of the atmosphere continued to accumulate, the consequence might be nothing less than universal uproar and ruin."

The writer, in concluding his letter (which I have somewhat curtailed, in order to avoid repetitions), observes, that he strongly inclines to the opinion, that the phenomena of light, heat, electricity, and the expansion of bodies, are all reducible to the operations of one most subtle and universally diffused effluvium, and that is the positive electricity of the atmosphere.

We are now come round, as it were, to the point from which we started—the existence of one great and general principle. Before entering upon more searching investigation of this conjecture, it will be due to the unknown author of the foregoing extracts to claim the scientific reader's attention to the perspicacity with which he hypothetically alludes to phenomena which observation and experience have established as leading facts. Electricity had at that period been little studied as an inductive science; and it now remains for me to retrace the advance and gradual progress toward the position, as such, to which it has now, in 1855, attained.

The word *Electricity* originated in the accidental discovery by Thales, about 600 years before the Christian era, that amber (*electron* in Greek), when rubbed, attracted light bodies—as a feather for instance—to its surface. Any one who has an amber-headed cane can satisfy himself of the fact, by rubbing its head over the surface of his dry warm hand. Similar attractions will

result by employing a glass tube or large roll of sealing-wax. Not to dwell upon details, we may assure ourselves that every act of friction, or simple contact, however simple, even that of two pieces of dry paper, and the mere percussion of the breath upon a window-pane, will disturb the latent electricities of the two bodies.

Until the commencement of the nineteenth century, our lecture-rooms were devoted chiefly to the exhibition of some curious experiments, astonishing in themselves, but little understood or philosophically appreciated. But when the identity of lightning and electricity was established by Dr Franklin in 1752, and still more awfully proved in the following year by the death of Professor Richmann at St Petersburg, philosophers were roused, and earnest researches were made to discover the laws that govern the action of the electric "fluid"—for so it was designated, though without sufficient reason.

During the remaining years of the eighteenth century the researches of the French chemists, Lavoisier, La Place, and others, threw some light upon the phenomena of electrical excitement by the evaporation of fluids, and by the solution of solid or alkaline bodies in acids. Thus in every instance of rapid chemical action, as that of the combination of carbonate of soda with tartaric acid, electricity was developed. Galvanism was accidentally brought to light, in 1791, by Professor Galvani, while he was dissecting a frog.

The celebrated Volta, acting upon the principle of induction, instituted a series of experiments, which terminated in the construction of his celebrated metallic pile of zinc and silver plates, the discovery of which was announced to the Royal Society by the late Sir Joseph Banks on the 26th of June 1800.

The discovery of that important pile was brought about by a very simple experiment, which any person can repeat without doubt of success. If two plates of metal, one of zinc and the other of silver (take as patterns the half-crown), are placed, one below, the other upon the tongue, and made to touch at their edges in front, a sensation of metallic and pungent flavour will be immediately perceived, and reproduced so often as contact of the two edges is repeated. And not only so; if the experiment be made in a dark room, a momentary flash of light within and between both eyes has been detected at the moment of contact.

The discovery of Volta introduced the science of voltaic electricity, and to that we are indebted for other surprising results which followed in rapid succession.

About the year 1809 the metallic bases of potash, soda, and lime, were discovered by Sir H. Davy by means of a voltaic trough, and many combined plates of copper and zinc. "With the powerful voltaic batteries that were constructed subsequently,

numerous compound bodies yielded up their elements. Substances that had resisted the greatest heat of the furnace were readily fused; and even the diamond was burnt in the voltaic arc, and its chemical character was identified with that of carbon."

The great discovery of electro-magnetism in 1819 followed, in consequence of a suggestion offered by Professor Œrsted of Copenhagen, that analogy exists between electricity and magnetism, the two powers acting reciprocally. And now, in 1855, no doubt can reasonably be entertained that they act, the one passing spirally round the other, as the spiral coil of bell wire would wind round a straight rod of iron inserted within it.

The discovery of magneto-electricity, and the mutuality of their exciting influences, pointed to a means of measuring their force, and galvanometers, or volta-meters of extreme sensibility, were constructed. Those instruments suggested application to the object of communicating signals. In 1830, M. Ampère pointed out the deflection of magnetic needles as the instruments by which this great project of intercommunication might be realised. But not to farther anticipate, we come to the following year, 1831, when Dr Faraday, of the Royal Institution, was enabled to prove, what he had previously inferred, that, "as a current of electricity induced magnetism, the magnetic force would induce electricity." Dr Faraday persevered in his experiments, and in 1832 commenced a series of researches into the nature of electro-chemical action, the results of which were communicated to the Royal Society, and subsequently collected in one volume 8vo, to the date of June 1838. That book, of 536 pages, I was favoured with by the author; and from it I am bound, in duty to my avowed object, to extract some important facts, which must astonish those tyros in electrical science, who have witnessed only the phenomena and interesting experiments of the lecture-room on static electricity.

I recur to Faraday's *Researches* (paragraph 505),—"I have reason to believe that, for a constant quantity of electricity, whatever the decomposing conductor may be—whether water, saline solutions, fused bodies, &c.—the amount of electro-chemical action is also a constant quantity; *i.e.*, would always be equivalent to a standard chemical effect, founded upon ordinary chemical affinity." This was a preconceived idea, and in 1833 carried out through many experiments, described in the 6th series, 1834. At section 13, "On the absolute quantity of electricity associated with the particles of matter," No. 852, allusion is made to the fact "that the electricity which we appear to be capable of loosening from its habitation for a while, and conveying from place to place, whilst it retains its chemical force, can be measured out, and, being so measured, is found to be as definite in its action as any of those portions which, remaining associated with the particles of matter, give them their chemical relation."

On the "decomposition of water" (par. 853) Dr Faraday says, "It is wonderful how small a quantity of a compound body is decomposed by a certain quantity of electricity. One grain of water, acidulated to facilitate conduction, will require an electric current to be continued for $3\frac{3}{4}$ minutes of time to effect its decomposition —which current must be powerful enough to retain a platina wire $\frac{1}{104}$ of an inch in thickness (and of any length) red-hot in the air during the whole time; and if anywhere interrupted by charcoal points, will produce a very brilliant star of light. It will not be too much to say that this necessary quantity of electricity is equal to a very powerful flash of lightning." Again, at paragraph 861, the Professor says, "I have endeavoured to make a comparison, by the loss of weight of such a wire, in a given time, in such an acid; but the proportion is so high that I am afraid to mention it. It would appear that 800,000 such charges of a Leyden battery, charged by 30 turns of a very large and powerful plate-machine in full action, would be necessary to supply electricity sufficient to decompose a single grain of water; or, if I am right, to equal the quantity of electricity which is naturally associated with the elements of that grain of water, endowing them with their mutual chemical affinity."

From the consideration of the stupendous volume of electricity associated with even a single drop of the purest water, a transition to the equally surprising phenomena of *the dew* could scarcely be deemed forced or unnatural. When Dr Wells produced his theory of that meteor, the scientific world appeared to grasp it as an oracle of truth; and from that time to the present moment inquiry has nearly ceased. Let us now, then, refer to this theory, and, in passing, analyse some of its leading positions.

Dew is the moisture insensibly deposited from the atmosphere upon the surface of the earth. This moisture is precipitated by the cold of the body on which it appears, and will be more or less abundant—not in proportion to the coldness of that body, but in proportion to the existing state of the air in regard to moisture. "Heat is radiated by the sun, and, if suffered to accumulate, would quickly destroy the present constitution of the globe. This evil is prevented by the radiation of heat from the earth to the heavens during the night, when it receives from them little or no heat in return. The surface of the earth, having thus become colder than the neighbouring air, condenses a part of the watery vapour of the atmosphere into dew. This fluid appears chiefly where it is most wanted—on herbage and low plants—avoiding, in a great measure, rocks, bare earth, and considerable masses of water. Its production, too, tends to prevent the injury that might otherwise arise from its own cause, because the precipitation of water upon the tender parts of plants must lessen the cold in them which occasions it."

This first and great position of Dr Wells is based upon the theory of radiation—an effect, and not a cause. It is a pure begging the question, or claiming the admission of a very disputable point; for instance—"The dew appears where it is most wanted, avoiding bare earth and masses of water;" yet who has not observed the accumulation of dew upon every small piece of dry straw in summer, and of hoar-frost in winter, when—and then only—that meteor is elsewhere present? Thousands of persons have noticed the ascent of vapour from the surface of ponds and pools of water, and have accounted for it by the comparative heat of the water itself.

But again, on the phenomenon of the dew, we are told "that dew appears only on calm and clear nights." Dr Wells shows that very little is ever deposited in opposite circumstances, and that little only when clouds are absent, or very high. It is never seen in nights both cloudy and windy; and if, in the course of the night, the weather from being serene should become dark and stormy, the dew which had been deposited will disappear.

I must not dwell too long on Dr Wells' theory, and therefore shall collect in a few lines, and thus present at a glance, the prominent heads that remain to be noticed. These are—

1. *The agency of dense clouds*, which, if near the earth, are said to reflect back the heat they receive from it by radiation.

2. *Cause of the dew.*—This Dr Wells traces to the principle that bodies become colder than the neighbouring air before they become dewed. "In the operation of this principle, conjoined with the power of a concave mirror of clouds, or any other awning, to reflect or throw down again those calorific emanations which would be dissipated in a clear sky, we shall find a solution of the most mysterious phenomenon of dew."

3. *A very slight covering will exclude much cold.*—Dr Wells found that grass, sheltered by a cambric handkerchief raised a few inches in the air, was upon one occasion 3° and on another 4° warmer than a neighbouring piece of grass with which the handkerchief was in contact. After all that has been said of radiation from the earth upwards, or from a counteracting radiation downward by a concave covering of clouds, we must look for the solution of the wonderful problem to that mighty agent which not only causes the radiation of heat, the vaporisation of water, its conversion into steam (that vehicle of much electricity), but also all those changes which are perpetually taking place in the aerial ocean. At the time when Dr Wells wrote (Aug. 1844), little was known of electricity itself—nothing of its all-pervading influences. If it be true that in the atmosphere its state is usually positive, yet changes are of frequent occurrence: if, therefore, the surface of the earth, by its thin electrical condition, be the attracting surface, the floating vapours will be brought down, and

deposited upon those vegetable points where the electricities meet and neutralise each other. On the other hand, if the clouds be the attracting medium, the floating vapours near the earth's surface (being in an opposite electrical condition, through the power of induction) will be drawn upwards, and become united to the attracting cloudy masses. I do not impugn the fact of radiation, but view it as an effect, and not a cause—which cause can only be traced to the electrising agency of that one great principle, the sun.

Connected with the phenomenon of the dew are the vapours of the atmosphere; and these, as being under the influence of electricity, I must not overlook, particularly as two beautiful phenomena came under my personal observation years before the electrisation of steam and watery vapours had become an established fact. During the month of January 1829, the trees, bushes, and herbage were at two distinct periods completely covered with frosty speculæ; every blade of grass, every twig, was thickly studded with masses of snow-white crystals. A mist or stratus had, at an early hour, overspread the whole surface of the ground; and as I stood upon an eminence overlooking Longleat Park, the more elevated portions of that woody domain appeared like islands raised above an ocean of white mist. This began to disperse about noon under the influence of a powerful sun; but still the frost remained severe, and the brilliant sun's rays produced only a partial effect in dissolving the rime. It was, however, taken up gradually and completely. On a recurrence of a similar hoar-frost on the 25th, the most striking circumstances were noted down. There was no wind, scarcely any air; there was no material difference in temperature; yet, without thawing, without any visible dissolution or dropping, the whole of the rime vanished—every particle disappeared. It was taken up in a short period of time, about noon. The transparency of the atmosphere was lost, and clouds formed. The temperature about 8 o'clock had been 16°; at 2 or 3 P.M., 24°; at night, 30°; on the day following, 40°, and rain fell. Here, and in similarly beautiful phenomena, we have striking evidences of the two attracting surfaces already referred to, when alluding to the fall and ascent of the dew.

Recent electrical discoveries.—In 1832, the late Professor Daniell invented his "constant" galvanic battery. He then observed the deposition of metallic copper upon the conducting plates. M. de la Rue had preceded M. Daniell in using a solution of sulphate of copper (blue vitriol) as the exciting fluid of an ordinary battery. He communicated the fact in the *Philosophical Magazine* of December 1836, observing, that "so perfect is the sheet of copper thus formed, that on being stripped off, it has the polish, and even a counterpart, of every scratch of the plate on which it was deposited. Here, then, we find the first proofs of electrotype.

In 1839, the earliest notice of a practical application of the discovery was made known through the *Athenæum* of May 4. Electro-plating followed, and now is carried to a high state of perfection. In 1840 a very unexpected source of electricity was accidentally discovered in high-pressure steam, issuing from a fissure in the boiler of an engine, at Seghill, near Newcastle. The engineer had one hand in the issuing steam, while he touched the lever of the valve with the other: he saw a bright spark, and felt an electric shock. The same effect was produced whatever part of the boiler he touched, provided one hand was in the effluent steam. At this point I would request attention to a phenomenon which has excited a good deal of speculation. If the steam of a high-pressure engine be turned off, and thus made to escape through the safety-valve, a prodigious rush of vapour will take place. This is invisible, perhaps, to the height of 5 or 6 feet, when it assumes the condition of steam.

If the hand pass into the invisible vapour within 10 or 12 inches above the valve, it will feel as if in a current of cool air. If it were presented to the steam above the vapour, the scalding heat would be insupportable for a moment of time. Why is this the fact? Let the enemies of electricity reply to the following question: Why is the stream which passes from a metallic point, fixed to the prime conductor of an electrical machine, felt like a gentle cool air? Is not the invisible vapour from the high-pressure engine so intensely charged with one of the electricities as to repel the particles infinitesimally, till it have induced an opposite condition in the air above it, when, a union of the two being effected, a neutral steam of scalding watery particles is the final result?

I refrain from alluding to thermo-electricity, and the effects produced by the combination of certain metals. Enough has been said to prove the existence of this mighty element of power everywhere and in everything. Its movements, it should appear, are not those of a current, but effected by a continuous or connected series of polarisations. Thus, for a minute example, let a shock from a charged jar be passed through a card, the holes made will be burnt, but its edges, on both sides of the card, will project outward, as if the charge had been made from within. Again, in those wonderful communications by telegraphic instrumentality, the wires seen above ground cannot of themselves complete the required circuit of intercommunication. A circuit must be established, and this is now done by introducing large copper plates into the earth at the two extreme stations. Thus the return is completed along the intervening moist ground, and forming what is termed the earth circuit. Wonderful are His works! Knowledge is good, so far as it is useful in our present state of existence; but it may "puff up." But wisdom is humble, that it knows no more, or rather nothing. Be it the chief desire of every pious mind to "magnify His works which men behold."

THE FARMERS' NOTE-BOOK.—NO. XLIX.

Planting in the Highlands. By David Gorrie.—"Desolate regions, almost destitute of trees, and with scarcely even heather." Such is the brief and not very flattering description of the Scottish Highlands given by Lavergne in his *Rural Economy;* and he speaks further of "perpetual snows and rain." As regards heather, it cannot grow on rocks, but it grows strongly on many a Highland muirland and sloping hill-side, affording sustenance to moorfowl and bees, and oftentimes even to sheep. And there are some rich glens in the Highlands, if they were cultivated—so rich is the pasture in one of them, that a fairy legend has been invented to account for the superior quality of the milk and butter there produced; and in these glens the sunbeams fall brightly on many a wild flower, and snow and rains are not "perpetual," though to a native of sunny France the climate may in general appear adverse. Of trees the north of Scotland is to some extent destitute, but far from being wholly so. There are native pines in Braemar, and there are larches in Atholl, the like of which, at their age, will not be seen in many countries out of Switzerland. And then as to trained plantations, Castle Toward and Glenfinnart offer specimens in the south-west, and the Bin Hill shows how young trees can thrive in the north-east; while Glenalmond and the Cairnies, in the middle, show thriving exotic trees, especially pines, as samples of what Scotland can produce in the way of timber, even in situations far from being sheltered, and when some of the exotic trees are of so tender a nature as to be destroyed occasionally by the hoar-frosts of the south of England. The frosts of April 1854 left araucarias uninjured at an altitude of 1700 feet on the hills of Scotland, while they scathed or altogether destroyed trees of the same species on the banks of the Thames. Mere altitude affects exotic trees less than relative situation; and the lower down some trees are planted the worse for them, if they are brought under the influence of dense-lying hoar-frosts. At the Cairnies, though the locality is bleak, and the altitude 600 feet, some pines thrive better than they do near Edinburgh; and there is a plant of *Araucaria imbricata* on a Mid-Lothian hill, and at an altitude of 1700 feet, thriving better than another at a distance of four miles, and at an altitude of only 800 feet, but in a valley where hoar-frost lies.

On those Highland hills which are in reality destitute of trees, plantations might be formed for the sake of sheltering and improving the pasture, or for the prospective value of the timber; and in both cases, ornament might be combined with utility, especially if the straight and narrow slip or belt were altogether excluded. When the Bin Hill was planted, about fourteen years ago, it was

thought by some that a demand for the timber of two thousand acres and upwards, in such a secluded locality, would never exist. But ere the first thinnings were marketable, the Great North of Scotland Railway was projected, and now that railway is opened to Huntly station, or within two miles of the plantation, and the continuation of the line of rails sweeps round the base of the hill. But every part of the Highlands cannot be equally favoured, and in most of the places at present bare of trees, shelter, ornament, cover for game, and timber for home use, form the main objects that the planter can have in view. These objects may, in a great measure, be accomplished by the same means. The narrow belt is neither good for shelter, for ornament, or for raising timber, whereas a large mass of trees, of irregular shape, can be made available for all three; and ornament is of importance in the Highlands, even in a pecuniary sense, since beauty of scenery leads many tourists there, and even enhances the price of estates that may be for sale.

The larch will continue to be planted over the primitive rocks of the Highlands, where no stagnant waters can remain near its roots, and where the rain water sinks in the rocks, or on hill-sides, where the soil and subsoil are free and gravelly. Even on low-lying and stiffy soils, perfect drainage may insure the larch against that disease which manifests itself in the rotting of its central layers of timber; but hoar-frost, in such situations, may sometimes check or destroy its buds in the spring months—the larch being a native of a country cold enough in winter, but having an early and rapid spring. It is so long since native forests of pine clothed the hill-sides of Scotland, now left bare, that the larch may be planted with safety on the sites of these forests, although this cannot be done where woodlands of the Scottish pine have recently been cleared—it being found that young larches, when planted where decaying roots of the pine exist in the soil, begin to decay in the heart, even before they reach their twentieth year.

The Indian cedar, or *Deodara*, has been for some years spoken of as a tree fitted for partially displacing the larch, and for becoming a valuable timber-tree in this country. It grows well at considerable altitudes in Scotland, and it is naturally adapted for a mountainous country, where much snow falls, as, when young and in a state of rapid growth, its leading shoots are always pendulous, and thus adapted for throwing off the flakes of snow as they fall. When the young wood at the extremities of the trunk and branches is in its second year, it gradually assumes an erect or horizontal position, but by this time the woody fibre is strong enough to bear the weight of snow. The length and flexibility of the shoots, in their first year, thus tend to their safety. The Lebanon cedar, which some consider but a variety of the other, makes shorter and

stiffer growths, and these can bear snow the first year; and young plants of the cedar of Lebanon show more or less of resemblance to young plants of the Indian cedar, just as their young shoots are more or less rapid in growth and flexible. The trees become similar in habit when old, and when their branches or tops cease to put forth leading shoots. The deodar, which can now be had in large quantities from British nurseries, will thrive in the same soil with the larch, only it inclines to coolness and moisture rather than to heat and dryness, if the moisture is not stagnant, but supplied to a free soil by a mountain stream or spring. Many are the steep Highland ravines which might be rendered ornamental and profitable by being filled with Indian cedars.

Amongst pines of modern introduction, the three that have been most extensively planted are, the cembran, Corsican, and Austrian. The cembran pine is well adapted for high altitudes, being a native of alpine regions; and planted in Scotland at an elevation of 1700 feet, it has maintained its dark-green hue from the first, while the common Scots fir has had its foliage *yellowed* for a year or two to begin with. But the cembran pine, from its spiral habit of growth, requires to be planted closely, if wanted for sheltering exposed places. If itself sheltered by neighbouring masses of native pine, it will grow nearly as fast as the trees that compose these masses, as far as height is concerned, but the stem will be much more slender, and the head not above half the breadth. If allowed light and air, it will maintain a close covering of branches from the ground upwards, and is therefore useful for mixing with the Scots fir, when it is intended to train that tree to a clear stem. As it maintains its spiral shape, however the wind may blow, it is useful for planting thickly on very exposed knolls, other kinds being planted in the more sheltered parts around it. The cembran pine claims the Scottish *knowe*, leaving the *muir* for the native species, the dry hill-side for the larch, the *brae* for the Austrian and Corsican, the sea-side for the pinaster, and the *cleugh* for the Indian cedar. Even though the soil may be very bare, the cembran pine will grow, if it can get its root fibres into fissures of rock; and as for the large main roots, they will be content to lie on the surface, twining among the loose stones like serpents, as the roots of araucarias do on the mountains of Chili. If planted on the *pitting* system, this pine should have its natural propensity for keeping its roots near the surface encouraged by being placed on a little raised mound of earth, instead of having its collar placed under the general surface-level, according to the too common system of deep planting.

The Corsican pine, in a lowland situation, and on a warm loamy soil, grows much faster than the common Scots fir—perhaps, on an average, one-fourth faster. But it will not do this at altitudes exceeding 200 feet, or in a cool soil, where the common pine finds

itself more at home, and therefore grows more rapidly in proportion. At 600 feet, on the Scottish muirlands, the native pine has rather the superiority; and at elevations higher than this it grows faster than the Corsican. Sometimes, however, the Corsican will begin to grow, after being planted, sooner than the other—maintaining its greenness in the first and second years, while the Scots fir may be looking yellowish. At high altitudes the Corsican, if wanted to grow tall and straight, should receive as much natural shelter as possible; and yet it is well fitted for withstanding the breeze, though not so stiffly as the cembran pine does. It offers its services as a very valuable timber tree, and as such—rather than as a tree fitted for giving shelter to pastures—it ought to be treated. This fine tree was so extensively planted in Scotland in the spring of 1854, that the nurseries were almost entirely cleared of the species. Like other pines and evergreen trees, the Corsican pine succeeds best when planted late in spring, except on soils that are liable to be affected by drought in spring and summer. It is true that pines often fail when planted in April or the beginning of May; but this might be prevented, if their roots, when planting is going forward, were saved from the influence of the drying winds of these months, by being dipped in mud as each bundle of trees is taken out of the earth, or else dipped in water, and then sprinkled with dry earth or dust.

The Austrian pine, a variety of the Corsican as is supposed, differs from it in habit, and promises in Scotland to be a sheltering rather than a timber tree. Unless planted very closely, it will refuse to be "drawn up" in exposed situations, and rather prefers sending out strong branches, so as to form a dense and irregular evergreen mass. If sheltered, it will, of course, form a timber tree; but if left exposed it will form a bushy head, as broad as it is high;—and at altitudes exceeding 500 feet it will, after having been planted from fifteen to twenty years, be at least one-third less high than the Scots fir planted near it, although in low and warm districts it equals our native pine in rapidity of growth. Its branching habit points it out as being well fitted for being planted along the exposed sides of woodlands; and the plants should there stand so thinly as to allow them to branch out freely from the ground upwards. They will thus grow low bushy trees, throwing the wind upwards ere it reaches the trees intended for timber, and also preventing those currents of wind that pass through plantations, under the branches of timber trees, when these are planted so closely as to form bare and clean stems. By the aid of the Austrian pine planted in this way, narrow plantations may be fitted for sheltering adjacent pastures, even although the trees on their least exposed side be allowed to grow up with clear stems; and both shelter and timber may be produced in this way by planta-

tions so narrow as to be inefficient for both purposes when the native pine alone is planted, and that in the usual close and crowded manner. It is to be hoped, however, that this property of the Austrian pine will not encourage the continuance of that "belt" or "stripe" system of planting, which is so injurious to the ornamental effect of many a Scottish landscape. The straight and narrow belt is the worst form for a plantation imaginable, whether the object be shelter, timber, or beauty.

Lambert's cypress may yet be a valuable timber tree, or tree for shelter, on Scottish hills, being hardy, and of remarkably rapid growth. Having been introduced only a few years ago, it is as yet but little known; but it thrives at an elevation of 900 feet, on the estate of Borthwick Hall, Mid-Lothian, as well as in Perthshire at a fourth of that altitude. It requires to be sheltered to some extent by taller trees, to prevent it from growing bushy or one-sided in exposed situations. The Morinda spruce seems fitted for a cold climate, growing, as it does, near the snow-line of the Himalayas; but its buds are often destroyed by the spring frosts of Britain, while other foreign pines and firs, from lower regions, receive no injury; and besides, the timber of the Morinda is considered in India to be soft and inferior.

The present high prices of timber encourage planting, both in Highlands and Lowlands. Some farmers begin to prefer wooden-framed ploughs to the more modern inplements that are made wholly of iron, and which have to go so often to the smithy to have their bolts re-screwed. This may lead to the increased culture of the ash; and the use of willow and poplar timber in railway carriage-sheds may bring about the adorning of many a river bank with these trees. The large-leaved maple promises to become a valuable timber tree, and grows faster than the common sycamore; but an early frost in autumn will blacken its leaves prematurely. The same degree of frost will effect this as causes premature blackening in the foliage of the walnut tree, and of the dahlia in gardens, and potatoes in fields—all being natives of countries where no frost comes in autumn till their leaves have fulfilled their natural term of office.

Unfavourable as are the terms in which Lavergne describes the soil and climate of our Scottish Highlands, he uses strong language in describing how well adapted they are for the culture of timber. "The late Duke of Atholl," he observes, "planted fifteen thousand acres with larch. This splendid forest, now of sixty years' growth, has sprung up with astonishing vigour, covering with its dark mantle the mountains north of the Tay around Dunkeld, and is not among the least of the beauties of that grand scenery. It is doubtful if Baden and the Black Forest are to be compared with it."

Doctoring of Seeds.—There are tricks in all trades, though, perhaps, there are fewer among farmers than amongst almost any class. But of this fact we are certain, that there is scarcely any class more liable to be imposed on than they are, by dealers who supply them with many articles which they may require in the course of carrying on their business. It is well known that there is a regular trade carried on in doctoring turnip and clover seeds. When these have not the fresh shining appearance peculiar to good seed, the unprincipled dealer is not slow in giving it to them. He rubs his hands over with oil, and turns over with them the seed intended to be doctored; now he gets a new supply of oil, then he dips his oily hands into a vessel containing the seed, turning it over and over till it has got the proper appearance. Sometimes a cheap seed is dyed to give it the colour of one more expensive, for which it is sold to the unsuspecting farmer. At another time worthless seeds are mixed with more valuable ones; and, to prevent the nefarious practice from being discovered by the bad seed germinating along with the good, the former is steeped in a chemical preparation, which destroys the germinating power of the seed, and is sold by one unprincipled dealer to another, not a whit better, as seed "warranted not to grow." It is then mixed with good seed, and unconsciously sold to the simple farmer.

But farmers sometimes try such tricks themselves. In several departments in the neighbourhood of Paris, when the wheat is not of a good colour, and does not pass smoothly through between the fingers, or, in short, does not handle well, many farmers are in the habit of doctoring it before it is brought to market. They rub a shovel with oil, with which they turn over the heap of wheat. One or two spoonfuls of oil are sufficient to grease twenty sacks of wheat; and this small portion of oil improves the appearance and feel of the wheat so much as to raise the price of it about one franc per sack. In Normandy they use cream instead of oil.

This certainly raises several grave questions for the honest farmer and dealer, the miller and the consumer. Is the greased wheat more prejudicial to health than the ungreased? Is the taste affected? Is the difficulty of grinding the greased wheat increased? How is the doctored to be distinguished from the pure wheat? These are questions which demand explicit answers. We do not think that if oil only is used in the process, the health of the consumer can be at all affected by it, particularly as such a small quantity only is employed. So long, then, as nothing else but oil and cream are used, we need not be alarmed for the dwining away of the unconscious consumer. The evil to him may be not from the use of the substances employed for doctoring the wheat, but from their concealing from him a damaged article which will not contain as much nourishment as he expected and bargained for,

and which, from the change which has taken place in its constitution (as in all cases of damaged vegetable matter,) may be prejudicial to his health.

We are not aware as to whether the taste of the doctored wheat is at all affected by the process, or whether there is greater difficulty of grinding it. The method recommended and practised in France for discovering the deception is to rub the suspected wheat in blotting paper, which becomes stained with the oil if any has been added to it.

One of the principal evils which result from this doctoring system, is the great hardship it imposes in general on the honest farmer and dealer. It would appear that the law in France at present is very undecided as to the mode and punishment of the delinquent. One tribunal, considering that it is a trick practised by a particular trade, similar to those employed by horse jockeys to improve the appearance of their horses before bringing them to market—in which case the law does not decide in favour of the unwary purchaser, who may not have exercised sufficient caution and observation in the transaction—does not impose any penalty, thus trying to put a stop to the practice by impressing upon the purchaser the necessity of greater caution. Another tribunal looks at it in the light of a fraud, being an attempt to deceive the purchaser as to the quality of the article exposed for sale. In such a case the penalty is often imprisonment for from three months to a year, besides the confiscation of the article and a smart fine. This severity of punishment is resorted to by some judges, with the view of putting down a practice which they consider injurious to the health of the people, and prejudicial to the interests of honest trading.

In either case the honest dealer is liable to suffer in the following manner. A farmer exposes his wheat, undoctored, for sale. A dealer, having perhaps a pique at him, and considering the price asked by him too high, informs the agent of police that he suspects the wheat is greased. It is seized, and the owner summoned before the court. He is obliged to employ an agent, and perhaps counsel to defend himself. The wheat is subjected to the examination of a chemist, and found to be correct, and the farmer is acquitted. But not only has he lost the market for his wheat, and all the expenses attending his suit, but he has been subjected to all that annoyance and vexation consequent on a law-plea.

Salt: its agricultural Properties and Uses—its stimulative effects and advantages in combination with ammonia.—

Of the long list of fertilisers, not one has suffered more from misunderstanding and consequent misapplication than salt, which is nevertheless so active, as well as cheap, that it will do good service to the farmer to give him distinct and definite notions of

its true properties, the purposes it is fit for, and the best methods of applying it. The two first of these points will be treated of in this letter; but to give practical directions for all its applications would require much more detail than would suit either your columns or my time. The intelligent and reasoning farmer will be able to modify these, according to the circumstances of his estate, when he clearly understands the properties and modes of action of salt, and the purposes for which it is really fit.

The properties of salt chiefly useful in agriculture are—

1. The supply of its constituents, soda and chlorine.
2. Attraction for moisture and resistance of freezing.
3. Sharpness, without being acid or alkaline; solubility and penetration of porous matters.
4. Promotion of putrefaction when used sparingly, though the contrary when used freely.
5. Mutual decomposition with lime and some of its compounds, as well as some other salts, giving rise to other and often more active fertilisers.

Let us next see what are its known effects, and to which of these properties they may be owing; and for our avowed purpose of distinctness we will consider them in three divisions:—

A. Effects of salt on the soil.
B. Its effects on other manures.
C. Its effects on the plant and seed.

A.—Its Effects on the Soil.

a. Keeps it moist in the heat of summer, and soft in the winter's frost (see above prop. 2); thus suits dry soils and seasons, whilst most other concentrated manures require wet.

b. By this, and its penetrating quality (3) it keeps everything in the soil in the softest and most soluble state, best fitted to work on each other, and to be acted on by the air and weather.

c. By its putrefactive power (4), it also promotes these reactions, thus digesting, so to speak, everything in the soil fit for vegetable nutrition, and preparing it to enrich the root-sap.

d. Kills all vermin, and most weeds also, if used freely enough, by its sharpness and penetration (3).

B.—Its Effects on other Manures.

e. Dung with salt has been found more effective for turnips than double the quantity of dung without; and ¼ dung to ¾ salted peat, worked into a rich soapy spit-manure, produced more turnips and potatoes than the whole four parts of dung alone. Both these cases appear due to the moistening and digestive actions already explained (*a*, *b*, *c*).

f. Worked with seeds, &c. kills all vermin, seeds, and roots, by its sharpness and penetration (*d*), and rots them (*a*) to a soft smooth paste, fit for the dung-heap, as it does not waste the ammonia like lime.

g. Undergoes decomposition with lime and its compounds (5); produces soda on its combination with carbonic acid, or with humus, all more powerful digestives and feeders than the salt itself: salt and lime work vegetable matters to decay quicker than salt alone.

With gypsum, it will supply soda and sulphuric acid cheaper than any other material, besides the muriate of lime so valuable for its moistening quality.

C.—Its Effects on the Plant.

h. It acts more favourably on some plants than others—those especially which naturally contain much of it.

It benefits root and green crops generally, more than those of corn, as might be expected from its moistening and digestive quality in the soil (*a*, *b*, *c*).

i. Pasture is, as well as roots, rendered more palatable and wholesome by its

entering into the sap by its solubility (3), and more nutritious by its digestive action in the soil and manures enriching the root-sap.

k. Low pastures are sweetened by it, though it is not alkaline ; but it becomes so by giving out some of its chlorine in the leaf (*m*).

l. Wheat and barley have less straw, but more ear and heavier grain.

m. It does not force the young plant, nor deepen the green (though chlorine is given off by the leaf in sunshine), but strengthens the growth by the enriched sap (*c*).

n. Germination seems rather to be even retarded by it, and the plant comes up small at first, due to its sharpness (3) and destructive tendency (*d*), but the plant soon fetches up and overpasses those which are not salted ; but implying also a stimulating action due to its sharpness (3), exciting to strong plants, but overpowering to weak ones.

o. Pease and other plants are said to blossom earlier, and grain to come earlier to harvest ; here again we recognise the stimulating action above alluded to, which excites vegetation, when used in due proportion, though oppressive to it when in excess (*n*).

p. Salts are much more abundant in the vital sap before flowering (the chief vital action) than after, and more in the sensitive plant than in others. Hence salts appear connected with vital energy, which may explain the stimulative actions above noticed (*n* and *o*).

This stimulating action is the most important fertilising property of salt, and seems to contrast remarkably with that of ammonia, each supplying the defects of the other. Ammonia forces the young plant, deepens the green of the leaf, produces a luxuriant juicy growth ; and in excess runs corn to straw and leaf, and often lays it with but little ear.

Salt, on the contrary, rather retards the young plant (*n*) ; does not deepen the green, but strengthens the after-growth (*m*) ; renders roots and green crops more solid and nutritious (*i*) ; produces more corn and less straw (*l*), and forwards blossoming and maturity (*o*).

Here, then, ammonia seems to give the early vigour and activity, and the luxuriant juicy growth, in which salt is deficient ; and salt to supply the strength and nutrition, which ammonia does not always produce, and also to bring the crops earlier to maturity.

Hence they would seem practically well suited to act together.

Moreover, ammonia was described as acting chiefly in the plant by promoting chemical transformation, and thus lightening the labour, so to speak, of the vital powers, and by encouraging absorption from the air. Salt, on the other hand, appears to act in great part as a digestive in the soil, to enrich the sap by the root, and in the plant as a stimulant to the vital forces. By ammonia the chemical changes in the sap seem liable to overrun the vital appropriation of the materials, and thus produce soft and juicy growth. By salt the vital action seems to be excited to select and arrange all the constituents, so as to give every part its due solidity.

Hence they appear, theoretically also, just suited to aid and correct each other. It would seem as though three parts salt compost to one of ammoniacal (dung) did better than all dung.

Now, if this be found a general law (and I have hitherto met with few facts opposed to it), how greatly will it add to our resources in manure !

If the deficiency of ammonia in the homestead dung-heap can be compensated by so cheap a material as salt, how greatly may the farmer improve his crops at a comparatively trifling expense !

And if the concentrated ammoniacal manures, as sulphate of ammonia and guano, may be actually improved by three or four times their weight of salt—thus reducing their cost per cwt. to one-third or one-fourth its present amount—how much more will they be within the means of the small farmer, and enable him to bring heavier crops to the market !

To recapitulate what we have said, we may expect from salt—

1. In the soil—retention of moisture and softness ; general penetration and digestion of all the materials of vegetable food to enrich the root-sap ; and destruction of vermin and of seeds when used freely.

2. On other manures—the destruction of all vermin, weeds, roots, and seeds ; the

digestive action just described; mutual decomposition with lime and its compounds, to the advantage of both; and an improvement in the efficacy of ammonical manures, whilst it greatly reduces their cost.

3. In the plant—improvement in the taste, wholesomeness, and nutritive power, and earlier maturity.—J. Prideaux, in *Plymouth Herald.*

The above remarks are most suggestive and instructive. But as some expressions made use of are, we think, rather calculated to mislead the practical farmer as to the mode of action of salt, we have thought it proper to subjoin the opinions of Professors Johnston and Way on the same subject. For instance, the term stimulant is made use of in several places, as if plants were endowed with systems similar to those of animals. If salt does stimulate the growth of plants, it does so solely from its supplying some of the food of plants more readily, either by giving up one or other of its constituents, or by acting chemically on other substances, and rendering them more available as food for plants. Potash and soda are both constituents of plants, besides "combining with and rendering soluble the vegetable matter of the soil, so as to bring it into a state in which it may be readily conveyed into the roots of plants. They may in this case be said to prepare the food of plants." Professor Johnston adds: "Green leaves under the influence of the sun have the power of decomposing common salt, and of giving off the chlorine to the surrounding air. When they have been introduced into the sap, therefore, by the roots, the plant appropriates so much of the chlorine they contain as is necessary for the supply of its natural wants, and evolves the rest. When common salt is thus decomposed, soda remains behind in the sap, and is either worked up into the substance of the plant, or it aids in disposing the organic matters contained in the sap of the plant to form such new combinations as may be required for the production of the several parts of the living vegetable." One of the great uses of salt in the soil is, after its decomposition, to assist, as the carbonate of soda, in rendering silica more soluble, and thus more available to grain crops for their straw. And Professor Way has shown that the silicate of ammonia, from which he supposes the silica of straw is principally derived, is more soluble in a solution of common salt than in pure water. "Hence," he says, "the action of common salt in strengthening and brightening the straw of wheat and barley, which is the best ascertained of its effects as a manure, is immediately traceable to the greater solubility of the silicate of ammonia in a saline solution."

On the Growth of Phornicum tenax, or New Zealand Flax, in the Western Highlands.—At the present time, when our supplies of flax from Russia are likely to be cut off, it is desirable that we should use every endeavour to provide ourselves with the necessary fibres for cordage and textile fabrics.

I wish to call the attention of our West Highland proprietors to the advisability of at least giving a trial to the growth of New Zealand flax, as in the mild and moist climate of that district I have great reason to believe it would be attended with success.

The *Phornicum tenax* is a *perennial* plant related to the aloe, and is indigenous only to New Zealand and Norfolk Island. It is truly described as a hardy plant, growing anywhere—in the midst of swamps, and to the tops of the barest hills. In the former situation it attains its rankest growth, having often a length of leaf of 8 or 9 feet. On the hills it is much more stunted, but its fibre is of a finer description.

There are said to be several varieties of the plant, and that some of these have a more valuable fibre than the others.

The expectations of a valuable export to Europe of this flax from New Zealand have not been realised. The causes have probably been the difficulty of cleaning it in sufficient quantities, and perhaps also the high rate of freight; for with the imperfect means of pressing the bales formerly in use, one ton of flax occupied two tons of measurement. Thus, with freight at £4 per ton, one ton of flax would cost £8 in carriage to England. Therefore by this amount at least would the West Highland grower have the advantage of his competitor in New Zealand.

That the difficulty experienced in clearing the flax, by removing the fibre from the vegetable matter and gum, would soon yield to the chemical or mechanical ingenuity of this country, I have no doubt whatever. The native process in New Zealand is to scrape each separate leaf with a mussel-shell, an operation performed with a peculiar knack almost impossible for a white man to acquire; but this process is too tedious to admit of success on the large scale.

Various plans of boiling in hot water and in alkaline leys have been tried by the settlers, but I cannot speak positively as to the results.

Although the export to Europe of this fibre has as yet been unsuccessful, yet a constant supply has been sent to the Australian colonies, where the cordage for their shipping is principally made of this material.

That the *Phornicum tenax* will thrive well in the Western Highlands, I think I have sufficient proof. Some years since, I was walking in the garden of the late Sir John E. Campbell, at Kildalloig, near Campbelton, when I was astonished by the discovery of the plant growing most luxuriantly to a height of 8 or 9 feet. I found that the nature of the plant was unknown, although it had been for many years in the garden. From this plant, I understand, many gardens in Kintyre have been supplied, and in them the plants have thriven. What now remains is to try

it in the open field; and here is opening for an experiment worthy of some of the enterprising agriculturists of Argyllshire.

I believe the plant will not thrive in the colder parts of Scotland. I removed two plants from Kildalloig to my own garden in Lanarkshire; and although they shot up during the summer, yet they died down to the roots every winter, until they finally expired during the hard frost of last season.

The advantages of the culture of *Phornicum tenax* would be, that a large portion of comparatively useless land might be made to produce a heavy and valuable crop, providing a material for our manufactures of which we are in want, while a great stimulus would be given to the industry of districts where agriculture may be said comparatively to languish.

What the amount of produce per acre would be, it is difficult to say. I remember a roughly-made estimate, that an acre would produce about 40 tons of green leaves, of which perhaps one-third might be fibre. The price of the cleaned flax in the Australian markets was, as near as I can remember, from £25 to £30 per ton for ropemakers' use.

In the culture of *Phornicum tenax*, it should be planted out in rows, at a distance of perhaps 6 feet from plant to plant, and the ground should be cleaned at the proper season.

It is probable that the vegetable part of the leaf, when separated from the fibre, might be useful as food for cattle. The *Phornicum tenax* ought equally to succeed in Ireland and the south-west of England.

JAMES C. CRAWFORD.

Consumption of Guano in France.—The Guano question is at present exciting a good deal of interest in France. Its importance as a valuable manure is being appreciated, and the consumption is only limited by the supply. The supply is very much curtailed by the regulations of the custom-house, which imposes a heavy duty on what is imported in foreign vessels, but allows what is brought in French vessels to enter free. At a late meeting of the "Société Imperiale et Centrale d'Agriculture," M. Boussingault brought this subject before the meeting, and alluded at the same time to the discovery made of a deposit lately in the Gallapagos Islands, in the Pacific Ocean, a short distance from the port of Guayaquil. "The honourable member added that several samples of that guano would arrive very shortly in Paris; and that after accurate measurements and calculations, the deposit was found to contain no fewer than 34,000,000 cubic metres * of guano. He stated that, having sailed in those parts some years ago, and touched at the group of Gallapagos Islands, he had observed some

* A cubic metre is equal to 35 cubic feet, 547 cubic inches.

deposits of guano; but they were inconsiderable, though they appeared to be as rich as those of the Chincha Islands, on the coast of Peru, whence it is brought in great abundance. He was astonished that the deposit—the discovery of which he intimated—had not been observed sooner; but he thought that the fact might be explained from the deposit being found on the island in the centre of the group of the Gallapagos Islands.

"M. Pommier said that he understood from an English journal that very recently a similar deposit had been discovered on the *Isle des Oiseaux* in the Atlantic Ocean.

"M. Yvart said, this information is the more interesting, as they had now commenced to consume a good deal of guano in France.

"M. Gareau observed that a most important question regarding the use of guano in France, is the custom duty with which it is burdened when imported. The French vessels which carry guano from Peru cannot hold more than 12,000 tons, and that which is brought in foreign vessels is subjected to heavy duty. The honourable member added that, on account of this difficulty, the consumption of guano in France is much less than that of England, and is only one-half that of Spain. He expressed the wish that the society would draw the attention of government to the subject."

M. Barral has also taken up the subject in the "Journal d'Agriculture Pratique." He says — "The question resolves itself into this: Is it just that our tariff, which considers manures as exempt from all duty, should make an exception for guano? That which arrives under the French flag is free, but that which enters under a foreign flag pays a duty of 23s. 6d. per ton. This duty is put on in favour of our marine, which allege that they cannot find sufficient return freight for the vessels which trade to the South Sea.

"All our readers know that guano is the excrement of penguins, which frequent in immense numbers the coasts and isles of the South Sea, and live entirely on fish. The deposits of guano are found on the coasts of Peru, Patagonia, Africa, and principally on the Chincha Islands, belonging to Peru. The Peruvian government has a monopoly of it, and it receives about £3, 7s. 3½d. for every ton of it. It has agents in different countries, who receive that sum, and sell the guano at such a price as to pay for freight, the expenses of charge and discharge, and storage, and leave a suitable profit. The freight at present has been raised from £2, 7s. 6d. to £4, 19s. The price, which for some years was £9, 18s. per ton, reached £11, 9s. 6d., and even £12, 13s. 6d. in the spring of 1854. The great demand for the manure certainly concurred to that result. It is a certain fact that there is not a single pound of guano to be got for money at present in France (5th

Feb. 1855). The demand for guano is now about 100,000 tons, while in 1854 it did not exceed 12,000 tons, the third part of which was taken by the department of the Seine-et-Marne.

"We are aware that the committees of several agricultural societies, when consulted by government, declared that guano would not be profitable to agriculture if it exceeded £5, 18s. 9d. per ton. The high price stated above contradicts this opinion, and it has in no way prevented the farmers from using their usual quantity. In England, guano is regarded as superior to poudrette, to rape-cake, to all kinds of manures, even at a price which sometimes reaches £15, 15s. per ton.

"In this situation, then, what occurs? Why, the importer of guano sells what is brought by French vessels, which have a monopoly, as dear as what is brought by foreign vessels. In fact, there is but one importer. It is just Paul paying the duty to Peter. The Peruvian government has no right to take advantage of us by making the farmer pay, in addition to the price which it exacts, the whole duty. The differential duty does not increase the importance of our commerce in the South Sea, for our ships prefer, in general, to take nitrate of soda or copper as return freight, than a substance like guano with such a disagreeable odour. Our consumption of guano, then, is much below the demand, and the price of it has not been made lower by any natural competition.

"The agents of the Peruvian government, in the face of an increasing demand, may employ foreign vessels, but they will not sell the guano at different rates; they will profit by the differential duty. And the demand will continue; for we feel convinced that a dressing of 900 lb. of good Peruvian guano, costing £5, 2s., at the rate of £12, 13s. 6d. per ton, will produce a sufficiently large crop to pay all expenses."

AVERAGE PRICE OF THE DIFFERENT KINDS OF GRAIN,

PER IMPERIAL QUARTER, SOLD AT THE FOLLOWING PLACES.

LONDON.

Date.	Wheat. s.	d.	Barley. s.	d.	Oats. s.	d.	Rye. s.	d.	Pease. s.	d.	Beans. s.	d.
1855.												
June 2.	79	3	33	6	27	1	41	10	41	11	41	5
9.	79	7	33	5	28	7	43	2	47	2	42	2
16.	81	4	33	4	28	4	46	0	45	8	44	0
23.	80	0	34	0	29	10	44	6	43	4	45	3
30.	79	6	35	5	28	2	43	0	44	4	42	8
July 7.	79	7	34	7	28	10	46	0	40	0	40	2
14.	78	11	35	8	29	1	45	8	42	10	44	7
21.	80	8	34	11	26	1	44	9	38	9	43	0
28.	80	5	35	8	28	7	46	6	41	6	43	3
Aug. 4.	80	3	35	2	29	5	47	6	44	4	45	0
11.	79	7	35	6	28	1	44	8	49	1	45	7
18.	78	10	33	0	28	3	43	1	47	7	43	10
25.	77	2	33	2	25	7	41	5	43	6	44	7

EDINBURGH.

Date.	Wheat. s.	d.	Barley. s.	d.	Oats. s.	d.	Pease. s.	d.	Beans. s.	d.
1855.										
June 6.	77	10	37	2	34	8	48	6	50	1
13.	75	1	36	11	33	11	48	0	49	1
20.	76	3	36	10	32	10	47	6	48	5
27.	75	7	36	8	33	3	47	0	48	1
July 4.	75	8	37	4	33	6	47	2	48	3
11.	77	1	37	6	33	4	47	6	48	7
18.	78	7	38	7	33	10	47	3	48	5
25.	77	3	37	2	33	11	47	0	48	1
Aug. 1.	77	6	36	11	33	10	47	6	48	9
8.	77	11	38	3	33	11	47	8	48	9
15.	76	1	37	1	33	3	48	9	50	6
22.	77	1	37	4	33	7	48	8	49	9
29.	81	11	37	11	33	9	48	6	49	8

LIVERPOOL.

Date.	Wheat. s.	d.	Barley. s.	d.	Oats. s.	d.	Rye. s.	d.	Pease. s.	d.	Beans. s.	d.
1855.												
June 2.	77	1	35	5	29	6	41	6	41	10	45	0
9.	77	7	34	11	26	8	42	4	42	4	45	8
16.	76	10	35	3	31	2	43	4	44	2	47	10
23.	74	2	35	3	27	0	44	6	42	6	49	0
30.	75	10	36	3	29	11	43	8	40	11	50	0
July 7.	76	8	35	4	26	6	43	1	42	2	48	1
14.	75	1	34	3	27	4	40	6	45	0	46	9
21.	77	8	33	2	29	10	42	4	46	4	47	6
28.	77	10	33	8	27	4	41	8	45	10	49	0
Aug. 4.	76	0	34	4	26	7	42	6	46	8	47	7
11.	86	10	33	8	31	8	43	4	44	6	48	4
18.	77	7	33	10	28	2	44	6	43	9	49	2
25.	75	3	33	11	28	5	45	2	42	6	51	0

DUBLIN.

Date.	Wheat, p. barl. 20 st. s.	d.	Barley, p. barl. 16 st. s.	d.	Bere, p. barl. 17 st. s.	d.	Oats, p. barl. 14 st. s.	d.	Flour, p. barl. 9 st. s.	d.
1855.										
June 1.	44	3	18	1	14	11	15	10	25	6
8.	44	5	18	9	15	6	16	2	26	1
15.	42	9	18	7	15	4	16	2	26	8
22.	41	9	18	7	15	8	16	3	26	6
29.	42	9	19	7	15	6	16	3	26	6
July 6.	42	2	19	3	15	4	16	9	26	4
13.	42	3	19	5	16	4	17	1	26	3
20.	43	0	19	7	16	3	17	5	26	6
27.	42	10	19	5	16	8	17	2	26	4
Aug. 3.	43	10	19	6	16	2	16	4	26	3
10.	42	11	19	4	16	1	16	11	26	2
17.	42	8	20	1	17	2	18	7	26	3
24.	42	4	19	10	16	10	17	1	26	1

TABLE SHOWING THE WEEKLY AVERAGE PRICE OF GRAIN,

Made up in terms of 7th and 8th Geo. IV., c. 58, and 9th and 10th Vict., c. 22. On and after 1st February 1849, the Duty payable on FOREIGN CORN imported is 1s. per quarter, and on Flour or Meal 4½d. for every cwt.

Date.	Wheat. Weekly Average. s.	d.	Wheat. Aggregate Average. s.	d.	Barley. Weekly Average. s.	d.	Barley. Aggregate Average. s.	d.	Oats. Weekly Average. s.	d.	Oats. Aggregate Average. s.	d.	Rye. Weekly Average. s.	d.	Rye. Aggregate Average. s.	d.	Pease. Weekly Average. s.	d.	Pease. Aggregate Average. s.	d.	Beans. Weekly Average. s.	d.	Beans. Aggregate Average. s.	d.
1855.																								
June 2.	77	7	73	7	33	2	32	2	28	2	27	1	44	7	42	1	42	3	40	6	46	4	43	8
9.	77	5	75	1	33	11	32	7	28	10	27	7	47	4	43	3	42	1	41	0	46	1	44	6
16.	77	5	76	5	34	0	33	0	28	7	28	1	45	10	44	6	43	6	41	9	46	6	45	3
23.	76	7	77	0	34	3	33	5	29	3	28	5	45	9	45	4	43	1	42	3	47	1	45	11
30.	75	11	76	11	34	3	33	9	28	8	28	7	45	6	45	7	43	8	42	6	46	6	46	3
July 7.	76	1	76	10	34	5	34	0	28	6	28	8	44	6	45	7	40	9	42	7	46	4	46	6
14.	75	11	76	6	34	7	34	3	28	8	28	9	44	8	45	7	42	4	42	7	45	11	46	5
21.	76	4	76	4	34	8	34	4	28	5	28	8	45	2	45	3	42	10	42	8	46	0	45	5
28.	77	7	76	5	34	8	34	6	29	1	28	9	43	1	44	9	42	4	42	6	46	4	46	4
Aug. 4.	78	2	76	8	35	0	34	7	28	11	28	8	46	11	45	0	42	5	42	5	46	11	46	4
11.	77	7	76	7	34	8	34	8	29	1	28	9	47	2	45	3	43	1	42	4	47	1	46	6
18.	75	9	76	11	34	2	34	8	29	1	28	10	42	4	44	11	43	7	42	10	46	6	46	6
25.	73	7	76	6	34	5	34	7	27	6	28	8	43	6	44	8	40	0	42	5	46	4	46	7

FOREIGN MARKETS.—Per Imperial Quarter, free on board.

Date.	Markets.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1855.		s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
June ..	Danzig	64 0 - 75 0	23 6 - 30 0	17 0 - 23 0	33 0 - 40 0	34 0 - 39 6	35 0 - 40 6
July ..	Danzig	66 0 - 78 0	25 0 - 32 0	16 6 - 22 0	35 0 - 42 6	33 6 - 40 0	36 6 - 42 0
Aug. ..	Danzig	67 0 - 82 0	25 6 - 32 0	18 0 - 24 0	36 6 - 44 0	35 0 - 42 0	36 0 - 42 6
June ..	Hamburg	63 0 - 76 0	24 6 - 32 0	16 6 - 22 0	32 6 - 38 0	33 0 - 40 6	34 0 - 41 6
July ..	Hamburg	66 0 - 78 0	25 0 - 33 9	17 6 - 23 0	34 6 - 40 0	35 0 - 42 0	35 6 - 42 6
Aug. ..	Hamburg	65 0 - 76 0	26 0 - 34 0	18 0 - 24 6	36 0 - 43 0	36 0 - 44 0	36 6 - 45 0
June ..	Bremen	56 6 - 68 0	24 6 - 32 0	15 6 - 21 6	32 6 - 39 0	34 0 - 42 0	33 6 - 41 6
July ..	Bremen	60 0 - 72 0	25 6 - 34 0	16 6 - 22 0	35 6 - 41 6	34 6 - 44 0	35 0 - 44 6
Aug. ..	Bremen	63 0 - 74 0	26 0 - 34 6	17 6 - 23 6	37 6 - 43 6	35 0 - 44 6	36 0 - 45 0
June ..	Königsberg	60 0 - 71 6	20 6 - 32 0	16 6 - 22 0	35 0 - 40 6	36 0 - 42 0	37 6 - 45 6
July ..	Königsberg	63 0 - 73 6	24 6 - 35 0	17 6 - 25 0	36 6 - 43 0	37 6 - 43 0	38 0 - 46 0
Aug. ..	Königsberg	66 0 - 78 0	25 6 - 36 0	18 6 - 26 0	38 0 - 45 0	38 0 - 45 0	38 6 - 48 0

Freights from the Baltic, from 4s. 3d. to 7s.; from the Mediterranean, 7s. 6d. to 14s. 6d.; and by steamer from Hamburg, 4s. 6d. to 7s. per imperial qr.

THE REVENUE.—From 30th June 1854 to 30th June 1855.

	Quarters ending June 30. 1854.	Quarters ending June 30. 1855.	Increase.	Decrease.	Years ending June 30. 1854.	Years ending June 30. 1855.	Increase.	Decrease.
	£	£	£	£	£	£	£	£
Customs	5,221,445	5,465,466	244,021	..	20,284,369	21,242,795	958,426	..
Excise	3,978,299	4,613,568	635,269	..	15,206,380	16,976,397	1,770,017	..
Stamps	1,773,358	1,828,300	54,942	..	6,916,320	7,187,892	271,572	..
Taxes	1,515,304	1,316,400	..	198,904	3,160,665	2,937,239	..	223,426
Post-Office ..	384,000	289,267	..	94,733	1,247,000	1,239,424	..	7,576
Miscellaneous	225,326	388,772	163,446	..	1,285,572	1,172,476	..	113,096
Property Tax	1,976,355	2,177,889	201,534	..	6,370,500	11,456,171	5,085,671	..
Total Income	15,074,087	16,069,662	1,299,212	293,637	54,470,806	62,212,394	8,085,686	344,098
	Deduct decrease....		293,637		Deduct decrease....		344,098	
	Increase on the qr...		1,005,575		Increase on the year		7,741,588	

PRICES OF BUTCHER-MEAT.—Per Stone of 14 Pounds.

Date.	LONDON. Beef.	LONDON. Mutton.	LIVERPOOL. Beef.	LIVERPOOL. Mutton.	NEWCASTLE. Beef.	NEWCASTLE. Mutton.	EDINBURGH. Beef.	EDINBURGH. Mutton.	GLASGOW. Beef.	GLASGOW. Mutton.
1855.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
June ..	6 9 - 8 9	7 3 - 9 3	6 9 - 8 6	7 0 - 8 9	6 6 - 8 6	6 3 - 8 3	6 3 - 8 3	6 6 - 8 6	6 6 - 8 6	6 9 - 8 9
July ..	7 0 - 9 3	7 3 - 9 0	7 0 - 8 6	7 3 - 8 9	6 6 - 8 6	6 6 - 8 6	6 6 - 8 6	6 6 - 8 9	6 9 - 8 9	6 9 - 8 9
Aug. ..	7 0 - 9 3	7 3 - 9 0	7 3 - 8 9	7 3 - 8 6	6 9 - 8 9	6 9 - 8 9	6 9 - 8 9	6 6 - 8 6	6 9 - 8 9	7 0 - 9 0

PRICES OF ENGLISH AND SCOTCH WOOL.—Per Stone of 14 Pounds.

ENGLISH.	s. d. s. d.	SCOTCH.	s. d. s. d.
Merino, ...	14 6 to 24 0	Leicester Hogg, ...	16 6 to 20 6
.. in grease, ...	11 6 to 16 6	.. Ewe and Hogg, ...	14 6 to 18 0
South-Down, ...	18 6 to 20 0	Cheviot, white, ...	12 6 to 16 6
Half-Bred, ...	14 6 to 16 6	.. laid, washed, ...	10 6 to 12 6
Leicester Hogg, ...	16 0 to 18 6	.. .. unwashed,........	8 6 to 10 6
.. Ewe and Hogg, ...	14 0 to 16 6	Moor, white, ...	8 0 to 9 6
Locks, ...	7 6 to 9 6	.. laid, washed,............	5 6 to 7 0
Moor, ...	5 6 to 7 6	.. .. unwashed,..........	5 0 to 6 3

The PRODUCTION, CONSUMPTION, and COMMERCE of GRAIN IN GREAT BRITAIN, AMERICA, and FRANCE.

By P. L. Simmonds,

Author of "The Commercial Products of the Vegetable Kingdom," &c.

No science, says Sir John Sinclair, can furnish such useful information—such important hints for the improvement of agriculture, for the extension of commercial industry, or for extending the prosperity of the State—as statistics.

Mr G. R. Porter, in his *Progress of the Nation*, published twenty years ago, truly observed that "it is much to be regretted that in this country, rich as we are in the possession of facts connected with many branches of social economy, we are almost wholly uninformed with regard to the statistics of agriculture." This want, at least as far as regards England and Wales, remains still unsupplied. For Ireland and Scotland we have at least some recent data to go upon; and it is to be hoped that the example thus set may be followed, and that this very important gap in our statistical returns may be filled up. The importance of the subject has been frequently discussed, and in several recent numbers of the Journal, agricultural statistics have occupied attention.

Agricultural statistics, to be worthy of the name, must be founded on facts entitled to confidence. In the absence of any reliable data, it has been impossible hitherto to determine with any degree of accuracy the amount of grain and provisions annually produced, the quantity stored, or whether a larger or smaller breadth of land has been sown in one season than another throughout the kingdom.

The injury that results from this ignorance has not been confined alone to the farmers, who are frequently outwitted by importers and others flooding the markets, but all dealers in and consumers of agricultural products are equally liable to sustain pecuniary loss therefrom, by making false calculations, and depending upon erroneous estimates. The shipowner, the merchant, the corn-dealer, the baker, and the wheat-grower in the colonies and foreign countries, all suffer from the absence of correct statistics as to the home production and consumption of grain.

Mr J. H. Maxwell, in his Report to the Board of Trade on the result of the agricultural census, 1854, taken under the auspices of the Highland and Agricultural Society of Scotland, makes honourable mention of the Scotch farmers as a body, who at once recognised the importance and utility of the inquiry, and endeavoured to support and forward it by readily and faithfully affording the information

required from them. Many of the English agriculturists, however, have regarded these inquiries with much apathy, and, where the investigation has been either discussed or attempted, have thrown such obstacles in the way that it would seem as if they feared that the information sought was to be applied to their disadvantage. It is believed, however, that the jealousy with which many viewed the attempts to collect information, under the fear that it might be used detrimentally against them by the Government, or their landlord, is gradually disappearing.

Towards the fourth quarter of the last century, we began to import largely of grain, the excess of imports of corn over exports having amounted in that period to about 20,000,000 quarters. From 1800 to 1837 the annual average of wheat and wheat-flour imported did not exceed half a million quarters; but subsequently to that year, on the repeal of the Corn Laws, the receipts from abroad began largely to increase, averaging in the next four years more than 2,000,000 quarters. While the quantity of all kinds of corn imported from 1843 to 1846 did not exceed, on the average, 4,000,000 quarters; the famine year, 1847, brought in immense supplies, reaching to nearly 12,000,000 quarters.

In the last fifteen years we have imported from various countries the following quantities of grain in quarters:—

	Wheat, (quarters.)	Other kinds of Grain, (quarters.)	Total, (quarters.)
1840	1,993,383	1,481,715	3,475,098
1841	2,409,754	848,944	3,258,698
1842	2,717,454	644,311	3,361,765
1843	940,120	365,396	1,305,516
1844	1,099,077	1,648,874	2,747,951
1845	871,710	1,286,017	2,157,727
1846	1,432,591	2,358,360	3,790,951
1847	2,656,455	6,780,222	9,436,677
1848	2,580,959	4,364,533	6,945,492
1849	3,845,378	5,806,578	9,651,956
1850	3,738,995	4,181,869	7,920,864
1851	3,812,008	4,281,393	8,093,401
1852	3,060,268	3,581,461	6,641,729
1853	4,915,430	3,932,178	8,847,608
1854	3,431,227	3,419,273	6,850,500
Total, qrs.,	39,504,809	44,981,124	84,485,933
Average,	2,633,654	2,998,741	5,632,395

We also received large quantities of flour and meal, namely—

	Wheat Flour.	Other kinds of Meal.	Total.
	Cwts.	Cwts.	Cwts.
1840	1,537,838	8,708	1,546,546
1841	1,263,126	12,530	1,275,656
1842	1,129,852	21,003	1,150,855
1843	436,878	5,584	442,462
1844	980,645	4,056	984,701
1845	945,864	3,052	948,916
1846	3,190,429	157,137	3,347,565
1847	6,329,058	2,304,933	8,633,991
1848	1,754,449	275,788	2,030,237
1849	3,349,839	162,001	3,511,840
1850	3,819,440	18,568	3,838,008
1851	5,314,414	18,955	5,333,369
1852	3,865,173	1,546	3,866,719
1853	4,621,506	16,504	4,638,010
1854	3,646,505	58,655	3,705,160
Cwts.,	42,185,026	3,069,020	45,254,035
Average,	2,812,335	204,601	3,016,935

Total grain and meal imported in imperial quarters:—

1840, . .	3,920,014	1845, . .	2,429,916	1850, . .	9,019,590
1841, . .	3,627,562	1846, . .	4,752,174	1851, . .	9,618,028
1842, . .	3,697,279	1847, . .	11,912,864	1852, . .	7,746,669
1843, . .	1,433,891	1848, . .	7,528,472	1853, . .	10,173,135
1844, . .	3,030,681	1849, . .	10,669,661	1854, . .	7,909,544

Average of the fifteen years, 6,497,965 quarters.

The aggregate imports of grain and meal in the eight years ending with 1847 (the famine year) were 34,804,381 quarters, being an average of 4,350,547 quarters; but in the seven subsequent years ending with 1854, the receipts were nearly double that amount, reaching to 62,665,099 quarters, being an average import of 8,952,157 quarters yearly. The conveyance of this quantity of grain and flour to our shores in the past fifteen years, has given employment to nearly 150,00,000 tons of shipping, or about 1,000,000 tons a-year.

The countries from whence we chiefly draw our supplies of bread-stuffs are indicated in the following return, showing the quantities received from abroad in 1847 and 1854 respectively:—

	Quarters of Grain and Meal. 1847.	1854.
Russia, northern ports, ...	1,600,026	169,565
Do., southern ports, ...	531,742	539,865
Denmark and the Duchies, ...	691,685	876,269
Prussia, ...	650,933	728,974
Hanse Towns, ...	214,873	420,489
Other parts of Germany, ...	221,535	365,190

	Quarters of Grain and Meal. 1847.	1854.
Holland,	180,645	250,358
France,	295,184	224,712
Italian States,	518,962	117,947
Wallachia and Moldavia,	463,212	147,090
Turkish dominions, not specified otherwise,	453,269	303,083
Egypt,	542,034	588,969
British North America,	485,642	84,757
United States,	4,288,239	2,136,223
Other countries,	754,883	956,062
Total quarters,	11,912,864	7,909,544

France and the United Kingdom contain a population of sixty-five millions, who are fast acquiring that higher standard of comfort which enables the masses to consume good wheat-bread in place of much cheaper vegetable food. In northern and central Europe, in Italy, in France, and the United States, brown bread and maize bread are gradually giving way to wheaten bread.

Place good wheaten bread and that made from Indian-corn meal on the tables of the million, and rye-bread, meal dumplings, and oatmeal porridge will in a few years cease to exist. Even in the British West Indies, Cuba, Brazil, and Central America, the consumption of American wheat and flour is largely on the increase, and is taking the place of plantains, yams, and other indigenous farinaceous food.

The estimates of the production of wheat in the United Kingdom vary considerably. I take it that the breadth of land under wheat at present is fully 5,000,000 acres, which, at a yield of four quarters per acre for a good harvest, would give a return of 20,000,000 quarters. The average import for several years past, we have seen, has been about 6,500,000 quarters of grain and meal. Of our home produce about 2,000,000 quarters would be required for seed, for starch manufacturing, and other purposes, leaving, say, 24,500,000 quarters to supply the population in ordinary years.

In view of the probable deficiency we shall experience next year, and the high price of wheat and bread, it appears very desirable to avail ourselves of various new farinas that might be introduced from the West Indian Colonies. The Manchester manufacturers might also revert to gum-arabic for stiffening purposes, now that supplies are large and prices cheaper, in place of the "dextrine," or "gum substitutes," made from flour and starch, to the extent of 50 to 100 tons per week. These products are doubtless to some extent manufactured from damaged flour and bad potatoes, but not wholly so. And the Belgian Government have just offered a premium of £400, for some starch product which shall not trench upon food-plants. Horse-chestnuts, acorns,

beech-mast, bitter-roots, and seeds, in the Colonies, and a hundred other substances are available to any extent.

Mr James Caird's estimate last year was 16,550,000 quarters, as the production of wheat in the United Kingdom, and 18,000,000 quarters as the consumption. In October, this year, Mr Caird calculated the wheat crop of the last harvest at 15,187,500 quarters, making an apparent deficiency of 2,832,500 quarters to be supplied from abroad. Another authority, Mr S. Sanders, of Hemel Hempstead, agreeing in the consumption, reduced the average growth of wheat to 13,500,000 quarters. M'Culloch reckons an average crop of wheat at 18,000,000 quarters, oats at 32,000,000, and barley at 10,000,000 quarters.

The *Bankers' Circular*, which has usually been considered a reliable and impartial authority, has given an estimate which is worth quoting; differing as it does materially from that of Mr Caird, who places our requirements for next year at a little more than 1,000,000 quarters. In considering this question, much will depend upon the ratio of consumption by which we calculate. Mr Caird places it at about 5½ bushels per head for 26,000,000 persons. Some statists reckon it as high as 1 quarter, but probably the medium of 6 bushels per head may be considered a fair average. What, again, is the population at present? On the 31st March 1851, the population of Great Britain stood at 21,000,000, and of Ireland at 6,500,000. In the five years which have nearly elapsed since then, emigration has drained us of 1,500,000 souls, and the natural increase of population will barely have filled up the gap. For all practical purposes, then, we may take the population of the United Kingdom at 28,000,000, and the annual consumption by these, at 6 bushels per head, would be 21,000,000 quarters.

But I will fall back upon the estimate of the *Bankers' Circular*, which is more moderate. The writer frames it upon the following deductions: He takes the quantity of wheat sold in the markets, whence the averages are drawn, as one-third of the total growth in England and Wales, and, adding the quantity imported, considers the total would furnish a near approximation to the consumption, if the produce of Ireland and Scotland is added. The figures thus given show an average annual consumption in the last six years of about 18,500,000 quarters.

	Home Produce. Quarters.	Imports of Wheat and Flour. Quarters.	Total. Quarters.
1849	14,361,949	4,802,475	18,164,424
1850	14,064,741	4,830,263	18,895,004
1851	13,461,123	5,330,412	18,791,535
1852	14,563,539	4,164,103	18,728,142
1853	13,682,736	6,235,860	19,918,596
1854	11,739,771	4,473,085	16,212,856

Assuming the estimate of the *Bankers' Circular* to be tolerably

accurate at 19,500,000 quarters for the present consumption of our population, and that an average crop would be 15,000,000 quarters (the produce of the increased average now being set off against the known deficiency of the last harvest, say one-tenth), we shall still require an importation of 4,500,000 quarters to supply our wants in 1856.

I differ with Mr Caird and Mr Sturge, who argue that a decrease in consumption follows the higher price of wheat. In bread, which is truly the staff of life of the million, there is much difference over other articles of consumption. In the metropolis and other large communities it is invariably found, that dear bread leads to an enhanced consumption, from this fact, that the poorer classes, having less money to spare for other accessory articles of food and sustenance, are obliged to purchase more bread. This was found especially the case in the famine year, and the bakers never had a larger trade.

Mr Colquhoun, an able statistical writer, about forty years ago calculated the consumption in Great Britain, for a population of 17,000,000, to be 9,170,000 quarters of wheat, and 25,780,000 quarters of other grain. Twenty years ago, Mr James Macqueen (*General Statistics of the British Empire*) estimated the land under culture in the kingdom, with wheat at upwards of 5,000,000 acres, and in other kinds of grain at 10,000,000 acres, his summary of the quantity and value of the grain crops being as follows:—

	Acres.	Produce per acre.	Quantity.	£
Wheat,	5,000,000	4 Qrs.	20,000,000 at 50s.	50,000,000
Barley,	2,000,000	5 ...	10,000,000 ... 36s.	18,000,000
Oats, &c.,	8,000,000	6 ...	44,000,000 ... 30s.	60,000,000
			Total value, .	£134,000,000

These figures, although too high at that period, are very near the mark now, except of course the value.

The estimated consumption of the cereals and pulse in Great Britain was thus given in 1825:—

	Quarters.
Wheat, ...	11,000,000
Barley, ...	8,000,000
Oats, ...	20,000,000
Pease and Beans, . . .	2,200,000
Rye, ...	800,000
Total Qrs. .	42,000,000

In Jacob's *Report of the Corn Trade and Agriculture*, the average production of wheat in England, in the eleven years ending with 1827, was stated at 12,760,000 quarters, 1,300,000 quarters being reserved for seed. The largest harvest was 16,000,000 quarters in 1820; the smallest 11,500,000 in 1824.

M'Culloch and other writers have estimated the agricultural population at 2,500,000. It has been common also to calculate the male field-labourers at 750,000. The late Mr G. R. Porter, in

his *Progress of the Nation*, among his classification of the occupations of the people, gives the families engaged in agriculture at each of the decennial periods, 1821 and 1831, at about one million. In Ireland, about two-thirds of the inhabitants are probably engaged in agriculture. These estimates of the agricultural classes are far too low. They may be taken at fully one-sixth of the population.

Mr Braithwaite Poole, a very careful and well-informed inquirer, in his *Statistics of British Commerce*, published in 1852, states that the annual average production of all sorts of corn in the United Kingdom has been estimated by competent parties at rather more than 60,000,000 quarters, and £80,000,000 in value; but in the absence of general official returns, we cannot vouch for its accuracy, although, from various comparisons, there are reasonable grounds for assuming this calculation to be as nearly correct as possible. Some persons in the corn trade imagine the aggregate production to approach almost 80,000,000 quarters; but I cannot find any data extant to warrant such an assumption.

According to this estimate, the produce of grain, &c. in different districts would be about as follows:—

	Wheat.	Oats.	Barley.	Beans, &c.
England, .	15,200,000	12,500,000	6,375,000	1,875,000
Ireland, .	1,800,000	11,500,000	1,120,000	540,000
Scotland, .	1,225,000	6,500,000	1,800,000	150,000
Quarters,	18,225,000	30,500,000	9,295,000	2,565,000

ESTIMATED ACREAGE.

	Wheat.	Oats.	Barley.	Beans, &c.
England, .	3,800,000	2,500,000	1,500,000	500,000
Ireland, .	600,000	2,300,000	320,000	130,000
Scotland, .	350,000	1,300,000	450,000	50,000
	4,750,000	6,100,000	2,270,000	680,000

M'Culloch, in his *Geographical Dictionary*, article "Scotland," assumed the distribution of the crops for North Britain to be as follows:—

	Acres.	Produce.	Total.
Wheat, . .	220,000	3 qrs.	660,000
Barley, . .	280,000	3½ ...	980,000
Oats, . . .	1,275,000	4½ ...	5,737,500
Beans and Pease,	100,000	3 ...	
	1,875,000		7,377,500

The statistics taken last year show the following figures for Scotland:—

	Acres.	Produce (quarters).
Wheat, . .	168,216	606,062
Barley, . .	207,507	954,950
Oats and rye, .	936,803	4,231,789
Beans, &c., . .	37,702	135,115
	1,350,228	5,927,916

The Irish Census Commissioners in 1854 returned the land under cultivation with cereal crops at:—

Wheat,	411,423 acres.
Oats,	2,043,466 ...
Barley, rye, &c.,	287,255 ...
	2,742,154 ...

According to the agricultural statistics partially taken recently in some of the English counties, under the Poor-Law Inspectors, it was roughly assumed that the land now under cereal crops in England and Wales might be taken to be—

Wheat,	3,807,846 acres.
Barley,	2,667,776 ...
Oats,	1,302,782 ...
Rye,	73,731 ...
Beans and pease,	698,188 ...
	8,550,323 ...

Having glanced at the production and consumption of grain in our own country, let us next examine the great American fields of production in the United States and Canada, which could, if necessary, supply us with all we require, supposing tonnage for its transport were available, and timely notice were given of the probable demand.

The shipments of corn of various kinds from the great grain depots of America and the Continent are now on an enormous scale; but those of the New World are fast outstripping the Old. Witness the following figures, showing the shipments from the principal ports:—

	Bushels of grain.
Odessa, 1853,	21,997,696
Galatz and Ibraila, 1851,	12,732,000
Dantzic, average,	4,408,000
St Petersburg, do.,	7,200,000
Archangel, do.,	2,128,000
Riga, do.,	4,000,000
St Louis, 1853,	5,081,488
Milwaukie, 1854,	3,747,161
New York, do.,	9,500,000
Buffalo, do.,	22,000,000
Chicago, do.,	14,286,400
Cleveland, 1853,	6,000,000

The Hon. J. Perkins jun., of the American Patent Office, in his report on the agriculture of the United States for 1853, states the following to be the amount of the several grain crops and pulse raised:—

Indian corn,	600,000,000 bushels.
Wheat,	110,000,000 ...
Rye,	14,000,000 ...
Oats,	160,000,000 ...
Buckwheat,	10,000,000 ...
Beans and Pease,	9,300,000 ...
Rice,	250,000,000 ...
	1,153,300,000 ...

Or 144,412,500 quarters.

The aggregate value of these crops he gives at £82,000,000 sterling. The value of the American flour alone exported in the year 1853 was nearly £3,000,000 sterling, or just double the value of that exported in 1850. The land under cultivation in the United States is about 118,000,000 acres.

An examination of the statistics of wheat production in America proves that by far the largest production is between the parallels of 40° and 50° lat.—comprehending Ohio, Pennsylvania, New Jersey, and the largest part of Illinois, which annually produce half the wheat raised in the United States. Compared with the production immediately south of them, the wheat raised in Michigan, Wisconsin, and Canada, is as yet comparatively small, but still largely on the increase.

The state of Ohio usually raises about one-fifth of all the wheat grown in the States. The laws of Ohio require the assessors to ascertain annually the precise breadth in acres of wheat and Indian corn planted, and the quantity produced. The acres planted in wheat averaged, in 1850 to 1852, 1,731,000; and the aggregate produce of those three years was 10,000,000 quarters, and the average 3,332,500 quarters. The average yield per acre of the three years was about 15 bushels.

In the year 1853 an average crop of wheat was raised in the United States, and, owing to the scarcity in Europe, as much as 3,000,000 quarters of flour and wheat was exported; but it left the home markets very bare. The domestic consumption of wheat by the white population may be taken at 13,563,000 quarters, and for seed 1,250,000 quarters—making an aggregate home demand of 14,813,000 quarters. Out of a crop of 25,000,000 bushels, Ohio can export about 14,000,000 bushels.

The following has been the production and export of wheat in the United States, in the past few years, in bushels:—

	Crop.	Export.
1849, . . .	100,485,944	6,000,000
1850, . . .	143,000,000	7,732,191
1851, . . .	101,000,000	12,038,380
1852, . . .	143,000,000	16,551,902
1853, . . .	110,000,000	24,000,000
1854, . . .	150,000,000	19,000,000

Taking the production of wheat in the principal States as given in the American census returns for 1850 as a basis, and estimating the probable increase this year over that, we have the following result in round numbers:—

	1850.	1855.
Ohio, ...	14,487,000	16,000,000
Pennsylvania, . . .	15,367,000	18,000,000
Virginia, . . .	11,232,000	12,000,000
New York, . . .	13,121,000	15,000,000
Carry forward,	54,207,000	61,000,000

	1850.	1855.
Brought forward,	54,207,000	61,000,000
Alabama, . . .	294,000	500,000
Illinois, . . .	9,414,000	13,000,000
Indiana, . . .	6,214,000	10,000,000
Iowa, ...	1,530,000	2,500,000
Kentucky, . . .	2,141,000	3,000,000
Maryland, . . .	4,494,000	4,000,000
Michigan, . . .	4,926,000	6,000,000
Missouri, . . .	2,981,000	4,000,000
Tennessee, . . .	1,619,000	3,500,000
Wisconsin, . . .	4,286,000	7,000,000
Total bushels, .	92,106,000	114,500,000

The above figures show an increase, as compared with the crop reported in 1850, of 22,000,000 bushels, but an American estimate, taking in the whole of the States, raises the amount sown 53,000,000 more. The aggregate yield in 1850 was doubtless much larger than indicated by the figures given, as is also the crop of the present year; but the statement shows the comparative yield. Last year the crop was smaller than in 1850 by at least 25 per cent; so that the increase this year, as compared with last year, is over 40,000,000 bushels. While it appears, from the figures thus far furnished, that the crop is not excessively large, it is also shown that there is sufficient quantity in the country to supply the home demand at moderate prices, and leave a moderate surplus for export. At the rate of increase at which the cultivation of Indian corn is progressing in the United States, the crop of 1860 will reach 900,000,000 bushels. In 1849 nearly 600,000,000 bushels were raised; and in 1854, 20,000,000 bushels were shipped. Ireland now takes 1,500,000 quarters of maize yearly.

In America, the average consumption of wheat in families using wheat bread, and occasionally some Indian corn and buckwheat, is stated to be 6 bushels per individual. Including all classes, the population is now about 26,000,000, of whom 20,000,000 are wheat-bread consumers. They will consume 120,000,000 bushels; and even on a crop of 150,000,000 bushels there would not be 30,000,000 bushels for export—leaving out of account any reserve for seed. The proportion for shipment has generally been about 12 per cent of the crop, varying slightly, however, according to the prices. At one dollar the bushel the American farmer is glad to grow wheat; but he seldom has this temptation,—the great irregularity of prices being one of the drawbacks to extended culture of wheat, which cannot, like Indian corn, be turned into cattle and hogs for export. The agriculture of a country cannot be changed in one or two years; available labour, probable demand, and remunerative prices are essential elements of consideration in the calculations of the cultivator. According to a reliable state-

ment of the price of wheat, kept at Albany, in the state of New York, it appears that, in the sixty-one years from 1793 to 1854, wheat has only five times been two dollars or upwards per bushel, while it was seventeen times at one dollar or under, and twice at seventy-five cents. Only once in thirty-seven years—that is, since 1817—until the present year has it reached two dollars. The average price for the whole sixty-three years is one dollar thirty-eight cents (5s. 9d.); for the last thirty years it is 5s. 2d. The present year, with war and short crops in Europe, and the Russian supplies cut off, is an exceptional year.

To ascertain the probable range of prices for the product of the incoming harvest, we must look at the average of recent years. The following figures give the American prices for the years ending 31st August:—

	Indian Corn per bushel.	Wheat per bushel.	Flour per barrel.
	Cents.	Dols. Cents.	Dols. Cents.
1848, . . .	28	83	4.50
1849, . . .	27	80	4.25
1850, . . .	45	88	4.75
1851, . . .	38	70	3.35
1852, . . .	31	60	3.15
1853, . . .	46	70	4.00
1854, . . .	52	1.30	6.75
1855, . . .	95	2.00	9.50

The cent is equal to a halfpenny.

Nothing can demonstrate more strongly the present productive power and the prospective agricultural wealth of the great West of America, than the official tables of the grain crops of that region. From reliable data we have received, it appears that Illinois alone has produced this year 16,000,000 bushels of wheat, or nearly one-tenth of the whole crop of the States; Ohio 20,000,000; Indiana 12,000,000;—these three States producing more than one-fourth of the whole wheat raised in the Union. The *New York Courier and Enquirer*, a sober and highly-respectable commercial journal, has taken great pains to furnish reliable estimates of the wheat production this year; and after extended inquiry and considerable research, gives the following tables, which seem entitled to full weight:—

Estimate of the Growth of Wheat in the different American States and Territories in 1855, as compared with the Production of 1847, as per Patent Office Report, and 1850, by Census Returns, viz.:—

	1847. Bushels.	1850. Bushels.	1855. Bushels.
Maine, . .	89,000	296,259	400,000
New Hampshire,	610,000	185,658	250,000
Vermont, . .	664,060	525,925	700,000
Massachusetts, .	256,000	31,221	100,000
Carry forward,	1,619,060	1,039,063	1,450,000

	1847. Bushels.	1850. Bushels.	1855. Bushels.
Brought forward,	1,619,060	1,039,063	1,450,000
Rhode Island,	4,500	49	...
Connecticut,	125,000	41,762	80,000
New York,	14,500,000	13,121,498	15,000,000
New Jersey,	1,100,000	1,601,190	2,500,000
Pennsylvania,	14,150,000	15,367,691	18,000,000
Delaware,	410,000	482,511	500,000
Maryland,	4,690,000	4,494,680	6,000,000
Dist. Columbia,	...	17,370	20,000
Virginia,	12,000,000	11,232,616	15,000,000
North Carolina,	2,350,000	2,130,102	4,000,000
South Carolina,	1,300,000	1,066,277	3,000,000
Georgia,	1,950,000	1,088,534	4,000,000
Florida,	...	1,027	550,000
Alabama,	1,200,000	294,044	2,000,000
Mississippi,	500,000	137,990	1,000,000
Louisiana,	...	417	...
Texas,	1,110,000	41,689	1,000,000
Arkansas,	200,000	199,588	1,000,000
Tennessee,	8,750,000	1,619,386	8,000,000
Kentucky,	6,000,000	2,140,822	5,000,000
Ohio,	16,800,000	14,487,351	20,000,000
Michigan,	8,000,000	4,925,889	7,000,000
Indiana,	7,500,000	6,214,458	12,000,000
Illinois,	4,900,000	9,414,575	16,000,000
Missouri,	1,750,000	2,966,928	7,000,000
Iowa,	1,000,000	1,530,581	8,000,000
Wisconsin,	1,200,000	4,286,131	7,000,000
Minnesota,	...	1,401	3,000,000
Kansas,	...	...	1,000,000
New Mexico,	...	196,516	500,000
Utah,	...	107,702	1,500,000
Oregon,	50,000	211,043	1,500,000
California,	...	17,328	3,000,000
	114,245,560	100,479,150	175,200,000

These estimates indicate a product of 75 per cent beyond that of 1850, or 175,000,000 in the aggregate. If we allow 3½ bushels of wheat per head (other grain being largely used), or 100,000,000 of bushels for home consumption, we shall then have on hand, for export or future stock, about 75,000.000.

Some of the States show a product of from 100 to 500 per cent beyond that of 1847—the Irish famine year. This increase is almost incredible; but we think the facts will fully bear us out in our estimates, viz.:—

Estimated productions of Wheat in some of the old, as well as the new States and Territories, in 1855, compared with 1847 and 1850, showing the vast increase in the supply:—

	1847. Bushels.	1850. Bushels.	1855. Bushels.
North Carolina,	2,350,000	2,130,102	4,000,000
South Carolina,	1,300,000	1,066,277	3,000,000
Georgia,	1,950,000	1,088,534	4,000,000
Tennessee,	8,750,000	1,619,386	8,000,000
Missouri,	1,750,000	2,966,928	7,000,000
Carry forward,	1,610,000	8,871,227	26,000,000

	1847. Bushels.	1850. Bushels.	1855. Bushels.
Brought forward,	1,610,000	8,871,227	26,000,000
Illinois,	4,900,000	9,414,575	16,000,000
Indiana,	7,500,000	6,214,458	12,000,000
Iowa,	1,000,000	1,530,581	8,000,000
Wisconsin,	1,200,000	4,286,131	7,000,000
California,	...	17,328	3,000,000
Minnesota,	...	1,401	3,000,000
Kansas and Nebraska,	...		1,000,000
Oregon,	50,000	211,943	1,500,000
	30,750,000	30,547,644	77,500,000

From 1847 to 1850 there was no increase; but from 1850 to 1855 the increase was 120 per cent.

States and Territories where there is a surplus produced beyond the consumption required for each, viz.:—

	Quantity Produced. Bushels.	Consumed. Bushels.	Excess. Bushels.
New York,	14,500,000	12,200,000	2,300,000
New Jersey,	2,500,000	1,800,000	700,000
Pennsylvania,	18,000,000	9,000,000	9,000,000
Delaware and Maryland,	6,500,000	2,500,000	4,000,000
Virginia,	15,000,000	4,500,000	10,500,000
N. Carolina, S. Carolina, & Georgia,	11,000,000	7,700,000	3,300,000
Texas and Arkansas,	2,000,000	1,300,000	700,000
Tennessee,	8,000,000	3,300,000	4,700,000
Kentucky,	5,000,000	3,000,000	2,000,000
Ohio,	20,000,000	9,000,000	11,000,000
Missouri and Wisconsin,	14,000,000	2,800,000	11,000,000
Illinois,	16,000,000	4,000,000	12,000,000
Indiana,	12,000,000	3,800,000	8,200,000
Iowa and Minnesota,	11,000,000	2,000,000	9,000,000
Missouri,	7,000,000	2,500,000	4,500,000
Kansas, New Mexico, and Utah,	3,000,000	700,000	2,000,000
California and Oregon,	3,000,000	1,800,000	1,200,000
Total,			96,600,000
Deduct:—			
Deficiency in ten other States,		12,450,000	
For seed and stock,		20,000,000—	32,450,000
Surplus for export,		bushels,	64,150,000

In order to show the relative productiveness of the several States, we have examined the subject carefully, and we think the following conclusions are very near the truth:—

Table showing the average number of bushels per acre, and the time of harvesting in each of the principal wheat-growing States.

State.	Average No. of bush. to Acre.	Time of Harvesting.
Maine,	7 to 12	Aug. 10 to Aug. 20
New Hampshire,	12 to 20	Aug. 1 to Aug. 10
Massachusetts,	10 to 20	July 25 to Aug. 10
Vermont,	15 to 25	Aug. 10 to Aug. 20
New York,	10 to 20	July 15 to Aug. 10
New Jersey,	15 to 25	July 1 to July 10
Pennsylvania,	12 to 22	June 20 to July 10

State.	Average No. of bush. to Acre.	Time of Harvesting.
Delaware,	12 to 20	June
Maryland,	10 to 20	June to July 1
Virginia,	10 to 20	June 10 to July 10
North Carolina,	8 to 15	June 10 to June 20
South Carolina,	8 to 12	June 1
Georgia,	8 to 12	June 1
Alabama,	8 to 15	June 1 to June 20
Tennessee,	8 to 12	June 10 to June 20
Kentucky,	12 to 15	July 1
Ohio,	10 to 20	July 1 to Aug. 1
Indiana,	12 to 30	June 20 to July 20
Illinois,	12 to 25	June 1 to July 25
Michigan,	15 to 25	July 10 to July 30
Iowa,	12 to 20	July 10 to July 25
Wisconsin,	15 to 25	July 15 to July 30
Texas,	20 to 25	May 15 to June 15
Oregon,	20 to 25	Aug. 1 to Sept. 1

Value of the Breadstuffs and Provisions exported from the United States to Foreign Countries, for each fiscal year, from 1846 to 1851, viz. :—

Years.	Value.—Dols.
1846	27,701,121
1847	68,701,921
1848	37,472,751
1849	38,155,507
1850	26,051,373
1851	21,944,651
1852	25,857,027
1853	32,985,322
1854	65,901,240

The number of acres cultivated in Canada in 1851 was 7,300,839; of these, 1,136,311 were sown with wheat, which yielded a little over 14 bushels per acre. Ohio had 9,851,439 acres under cultivation, 1,231,437 of which were in wheat, and yielded 14,487,351 bushels, or 12 bushels per acre. The greatest yield of wheat in Upper Canada in 1851 was in Esquesing, which gave 26 bushels 35 lb. per acre; and the lowest in Mark Lane, 18 bushels 43 lb. per acre. Megantic gave the highest in Lower Canada, 15 bushels 29 lb.; and L'Islet the lowest, giving only 6 bushels per acre. The great variation in the yield is accounted for by the ravages of the weevil, which were very severe in 1851. The total growth of wheat in all Canada—the flour and wheat exported having been 4,276,871 bushels, and the consumption (allowing 5 bushels for each inhabitant in a population of 1,842,265) 9,211,325 bushels, and for seed at 1½ bushels per acre—would be 15,162,662 bushels. The census returns gave an excess of 1,000,000 bushels beyond this in 1851; namely, 16,202,272 bushels.

The total wheat crop of Upper Canada in 1841 was 3,221,991 bushels; in 1851, 14,768,730 bushels; in 1852, 12,692,852. The *surplus* in 1854 (after deducting 6,000,000 for domestic consump-

tion) was 12,000,000 bushels, and the population is under 1,000,000. The increase in all other crops and products of agriculture in the province was very nearly in the same proportion. The average produce per acre was increased in the ratio of 13 to 18 between 1845 and 1854, owing principally to improved farming, and to better clearings of land.

The combined population of Canada may now be taken at 2,500,000. With the increase of population, and greatly extended cultivation of land in Western Canada, the crop of wheat of 1855 cannot be estimated at less than 25,000,000 bushels.

The production of Indian corn in Canada is very small, amounting to little over 2,500,000 bushels, but last year they began to export their grain.

The exports of agricultural produce from Canada were, in

	1847.	1853.	1854.
Wheat, bushels,	719,688	2,666,903	1,442,677
Flour, barrels,	670,808	786,058	651,400
Indian corn, bushels,	...	831	57,636
Barley and rye, do.	25,332	43,353	112,383
Meal, barrels,	22,038	4,031	4,842
Beans and pease, bushels,	121,570	243,770	133,651
Oats, do.	168,672	1,028,310	83,656
Potatoes, do.	...	6,477	7,568

In 1853, it will be seen 2,666,903 bushels of wheat were exported, and in 1852 nearly 2,000,000 bushels.

The following comparison shows the relative production of Canada and the United States as regards the grain crops:—

	United States.		Canada.	
	1840.	1850.	1842.	1851.
Wheat, bushels,	84,823,272	92,086,000	3,221,991	16,155,946
Barley, „	4,161,504	5,167,016	1,031,335	1,389,499
Oats, „	123,071,341	146,567,879	4,788,167	21,434,840
Rye, „	18,645,567	14,188,639	292,370	869,835
Maize, „	377,531,875	592,326,612	691,359	2,029,544
Population,	17,067,453	23,091,488	1,176,837	1,843,500

From the above table it will be seen that, in proportion to the extent and population, Canada is a more agricultural country than the United States. The usual quantity allowed for the consumption of each inhabitant is generally five bushels, which would leave for export six or seven million bushels of wheat. The great quantity of Indian corn grown in the States enables them, by making it a staple of consumption, to export a large stock of flour. In Canada, little Indian corn being grown, wheat becomes of necessity the great staple of food.

I will take one more country into consideration—the great empire of France, which ranks high as a producing country. Mr Henry Colman, in his remarks on the rural economy and agriculture of the Continent, from personal observation and in-

quiries, seven years ago, observes that, with the exception of Russia, from which no accurate statistical returns have been obtained, more than one-half of the wheat grown in Europe is produced in France—the yield, twenty years ago, having been about 24,832,500 quarters, now 28,000,000 quarters.

From 1843 to 1847, while wheat averaged the high price for France of 59 francs, the whole imports in the period were but 20,161,000 hectolitres, from which deducting 1,164,000 of exports, there remained for local consumption only 6,400,000 quarters. In the period of scarcity, from 1816 to 1821, when the price was 54s. 5d., the imports were only 6,247,000 hectolitres in six years, or about 345,000 quarters annually; so that these figures bear evidence of the capability of France to maintain its population from its indigenous resources in ordinary years, without the assistance of extraneous supplies. This year, according to the *Moniteur*, the wheat crop of France is 7,000,000 hectolitres, or about 2,300,000 quarters short of an average.

IMPORTATIONS OF WHEAT AND FLOUR INTO FRANCE IN 1846 AND 1847.

	Hectolitres Wheat.	
From Russia,	4,706,116	
Sardinia,	2,191,109	mostly re-shipments of Russian Wheats.
Turkey,	2,182,484	„ „ „ „
Egypt,	247,518	
England,	894,773	
Germany,	667,647	
Belgium,	563,087	
Sicily,	505,151	
America,	374,730	and 497,794 quintals Flour.
Tuscany,	279,774	
Spain,	247,242	
Hanse Towns,	212,899	
Denmark,	179,434	
Mecklenburg,	141,209	
Roman States, Holland, Algeria, Austria, &c.,	262,167	
Sundry places,	—	300,000 „ „
Total,	13,655,340	797,794
Equal to . qrs.	4,708,738	1,567,095 cwt.

IMPORTATION AND EXPORTATION OF GRAIN INTO AND FROM FRANCE FROM 1816 TO 1852.

	Imported in excess of Exports.		Exported in excess of Imports.	
From 1816 to 1821,	6,247,178	hectolitres	—	hectolitres.
„ 1822 „ 1827,	—	„	1,248,601	„
„ 1828 „ 1832,	9,527,466	„	—	„
„ 1833 „ 1837,	—	„	944,130	„
„ 1839 „ 1842,	1,126,473	„	—	„
„ 1843 „ 1847,	18,697,132	„	—	„
„ 1848 „ 1852,	—	„	12,187,416	„

The hectolitre contains 22 imperial gallons, 3 hectolitres being a trifle more than a quarter.

In 1853, France imported 4,184,190 hectolitres of wheat, spelt,

and meslin, of the value of 92,637,966 francs; 313,671 metrical quintals of flour; 83,351 hectolitres of rye; 111,000 hectolitres of barley; 66,773 do. of oats; and 24,603 do. of maize.

The average production of wheat in France is estimated a 80,000,000 hectolitres (about 28,000,000 quarters), the highest production during the last twenty-five years having been 97,000,000 in 1847, and the lowest, 52,000,000 in 1830. In the United Kingdom, out of about 50,000,000 acres under cultivation, 15,000,000 are sown in wheat and other cereal crops, while in France 50,000,000 are cultivated for grain; but while the average growth of wheat per acre in England is fully 3 quarters, in France it is but $1\frac{2}{5}$ quarters. The growth of wheat has increased very much of late years—much faster in proportion than the population; and there are numerous evidences that the bulk of the people are much better fed and in a more prosperous condition than they used to be. The following table will show the progress of the population and production during the last twenty-five years:—

Years.	Population.	Average production of Wheat in five Years.	
1831	32,569,223	From 1827 to 1831	57,821,336 hectolitres.
1836	33,540,910	„ 1832 „ 1836	68,684,919 „
1841	34,240,178	„ 1837 „ 1841	71,512,258 „
1846	35,400,486	„ 1842 „ 1846	72,015,564 „
1851	35,781,821	„ 1847 „ 1851	86,121,123 „

The highest and lowest annual average price of wheat in France during the fifty years from 1803 to 1852, taken in intervals of five years, has been as follows:—

	Lowest price. F.	c.	Highest price. F.	c.	Average of five Years. F.	c.	
From 1803 to 1807	18	60	20	19	19	59	ꝑ hectolitre.
„ 1808 „ 1812	15	18	34	34	22	39	„
„ 1813 „ 1817	17	78	36	16	24	86	„
„ 1818 „ 1822	15	89	24	65	19	18	„
„ 1823 „ 1827	14	31	18	31	16	58	„
„ 1828 „ 1832	21	17	22	59	22	04	„
„ 1833 „ 1837	14	72	16	37	15	94	„
„ 1838 „ 1842	18	34	22	49	20	35	„
„ 1843 „ 1847	18	93	29	38	22	28	„
„ 1848 „ 1852	14	26	17	50	15	60	„

The lowest average was f. 14.26=33s. per qr. in 1850, the highest f. 36.16=76s. 8d. per qr. in 1817. The ten years' averages during the above periods have been:—

	F.	c.
1803 to 1812	20	99
1813 „ 1822	22	02
1823 „ 1832	19	31
1833 „ 1842	18	14
1843 „ 1852	18	94

And the general average for the same fifty years was f. 19.88= 46s. 1d. per quarter.—Catling & Co.'s *Corn Circular*.

The following have been the yearly averages per hectolitre:—

	F.	c.		F.	c.
1846, . .	28	86	1850, . .	14	26
1847, . .	29	38	1851, . .	14	64
1848, . .	16	36	1852, . .	17	50
1849, . .	15	25			

The average price of wheat in France in the three years 1851, 1852, and 1853, was 43s. 3¼d. per quarter.

In the year ending September 1, 1854, France received from foreign countries nearly 8,000,000 hectolitres of wheat, and about 1,000,000 quintals of flour, equal to nearly 2,000,000 more hectolitres, to make up for the deficiency of its grain crop, which was fully 10,000,000 hectolitres below the average product. This was almost all for home consumption, for the exports did not amount to 2700 hectolitres of wheat, and 5000 quintals of flour.

According to the *Statistique Territoriale*, the cultivated area under grain a few years ago in France was—

	Hectares.	Average crop in hectolitres.
Wheat, . . .	5,586,786	12.45
Rye, ...	2,577,253	10.79
Barley, . . .	1,188,189	14.02
Oats, ...	3,000,634	16.30
Maize, . . .	631,732	12.06
	12,984,594	

The hectare is about two acres.

The average price of wheat in England, in the ten years ending with 1847, was 51s. 2d. the quarter, having reached 69s. 7d. in 1847. In 1849 it had dropped to less than one-half that price, the average being 33s. 9d.; in 1850 to 1852, it was from 38s. to 41s.; in 1853, 53s.; and in 1854 the price ranged from 80s. to 52s. 6d.

The average produce of wheat per acre in France, prior to 1844, according to an official report, was under 14 bushels; but the foregoing returns make the produce equal to about 17 bushels to the acre.

The progress of Algeria as a grain-exporting country is worthy of notice, particularly since the adoption of the customs law. The shipments have advanced in the following ratio:—

	Wheat.	Barley.
1850, . . .	2,868 hect.	10,856 hectolitres.
1854, . . .	1,033,718 „	559,048 „

So that in four years the export of corn from thence has risen from 13,700 hectolitres to about 1,600,000 hectolitres, besides about 100,000 shipped as flour and biscuits to the army in the East.

There was under culture with grain in Algeria last year 707,852 hectares, which produced 9,124,571 hectolitres.

The production and export of grain in Russia and Germany,

in India and Australia, in Chili, and other quarters, would form an interesting review; but this would lead me too much into detail to be followed out in the present inquiry. The reliable facts and figures already adduced in this paper may, however, prove useful to some who have not the same advantages of careful elaborate research, and will at least serve to mark the rapid advance making in the culture and commerce of grain abroad.

It is evident, from the facts adduced and the opinions cited, that our own wheat crop, and that of France and some other continental countries, is deficient, and we shall have to look for increased foreign supplies next year. These we shall have no difficulty in obtaining from America, and probably at cheaper rates than they could be produced at home, in consequence of the deficiency of labour, by the drafts for the army and navy and the larger emigration. It will be seen that our home consumption has gone on increasing, being largely in excess of the average of other countries, where the population are not so well fed.

Our agriculturists have made great advances in improved culture, in the general principles of tillage, drainage, choice of seeds, manures, &c.; but there is still much room for progress, and we cannot but agree with the remarks recently made by Lord Stanley, who observed that there were some 15,000,000 of acres yet unreclaimed, which were available for tillage, and we as yet cultivate but three-fifths of our soil, and much of that very badly. It has been proved that, by applying to the fullest extent the resources of modern science and the improvements in tillage and culture, we may draw from the land three times the amount of sustenance which it at present yields; and if this principle were generally carried out, the possibility of feeding a largely-increased population would become a reality, and we should become thoroughly independent of foreign supplies.

ON RED CLOVER.

THERE are few of our cultivated plants, the introduction of which into this country produced greater changes in our systems of agriculture than red clover. There is none which appears to be more capricious in its growth, and has caused more anxiety in its cultivation to the farmer. From the prominent place it holds in all good rotations, its intrinsic value as a forage plant, the importance attached to it as a restorative to the soil for other crops—its indispensableness, in short, to the farmer—we are apt to wonder how our forefathers got on at all without it.

Yet its general cultivation in England and its introduction into Scotland are of comparatively recent date; and, like all great improvements, its cultivation was looked upon with suspicion as a useless innovation. Fortunately we can get a glimpse into those dark ages of agriculture before its introduction, and are thus enabled in some measure to gratify our curiosity as to how farmers cultivated their lands then. For men of learning and intelligence had by that time begun to direct their attention to agricultural pursuits, and were endeavouring to enlighten their more ignorant brethren, both on the theory and practice of their art.

Nor do we require to go very far back; for the state of agriculture at the time immediately preceding the introduction of clover may be taken as a type of what it was more than a century before,—so slow had been its progress during that period. Internal commotions, foreign wars, no difficulty in raising a sufficient supply of food for the population, and a want of stimulus, generally, to the exertions of the husbandman, were the main causes of the slowness of progress. Three white crops between fallow and fallow was the prevailing rotation throughout England; and on the best managed farms, an alternate white crop and fallow was practised. As might be expected from there being no turnips for the winter food, nor clover for the summer food, of cattle, stall or close feeding was comparatively unknown, excepting where some of the nobility may have put up an animal or two for their own use. But even this must have been rare, for we find that the highest families generally lived on salted meat throughout the winter,—the oxen or sheep required for this purpose being slaughtered when the pastures failed.

In Scotland things were even worse; for we find that Ray, in travelling along the eastern coast in 1660, or fifteen years after the introduction of red clover into England, says that "he observed no fallow grounds in Scotland." And Donaldson, giving a description of the management of a farm in 1697, says that "it is divided into two parts; viz., one-third croft, or infield, and two-thirds outfield. The croft is usually divided into three parts; viz., one-third barley, which is always dunged that year barley is sown thereon,—one-third oats, and the last third pease. The outfield is divided into two parts; viz., one half oats, and the other half grass, two years successively." And about twenty or thirty years after, Lord Belhaven informs us that the rotation in the infield was, 1st pease, 2d wheat, 3d barley, 4th oats; that the outfield was generally made use of for the feeding of their animals, and sometimes, when they had much of it, they fallowed a part of it yearly. And even so late as 1757, we do not find clover introduced into the rotations in Scotland; for Mr Maxwell, writing in that year, states that the *best* husbandmen after a fallow take a crop of wheat, then pease, then barley, then oats, and after that they fallow again.

To Sir Richard Weston is due the merit of having introduced the cultivation of red clover into this country about the year 1645. Having resided for some years in different countries on the Continent in a diplomatic station, on his return home he published his *Discourse on the Husbandry of Brabant and Flanders*, in which he gave particular directions for the cultivation of the great or red clover. "It thrives best," he says, "when you sow it on the worst and barrenest grounds, such as our worst heath-ground is in England. The ground is to be pared and burnt; unslacked lime is to be added to the ashes. The ground is next to be well ploughed and harrowed; and about ten pounds of clover seed must be sown on an acre in April or the end of March. If you intend to preserve seed, then the second crop must be let stand till it come to a full and dead ripeness; and you shall have at the least 5 bushels per acre. Being once sown, it will last five years; and then being ploughed, it will yield, three or four years together, rich crops of wheat, and after that a crop of oats, with which clover-seed is to be sown again. It is in itself an excellent manure." Other writers of the same period, particularly Blythe, in his *Improver Improved*, pressed the cultivation of clover upon the attention of farmers. But notwithstanding, it appears to have made but slow progress; for we find Jethro Tull writing in 1740, "The sowing of artificial grasses was so long before it became common amongst farmers, that though Mr Blythe wrote of it in Cromwell's time, yet thirty years ago, when any farmer in the country where I live was advised to sow clover, he was certain to say, 'Gentlemen might sow it if they pleased; but they (the farmers) must take care to pay their rent;'—as if the sowing of clover would disable them from paying it; and now the case is so much altered, that they cannot pretend to pay their rent without sowing it, though the profit of it is vastly less since it has become common than before; and the improvement, after all, was no more than doing the same thing on this side the water that was done before on the other."

Its value as a forage crop was soon appreciated; for shortly after its introduction, we read of its being used for the soiling of cattle in England.

In Scotland the progress of its cultivation was as slow as its introduction was tardy. For though one of the Earls of Haddington, and Cockburn of Ormiston, had grown it about 1730, their example was not generally followed even in their own neighbourhood for more than thirty years after.

The red clover (*Trifolium pratense*), includes two varieties; the one perennial and indigenous to this country—the other biennial, introduced from the Continent. To the former class belongs cow grass; to the latter the common red clover cultivated in the fields. It is with this plant, however, as with most others—culti-

vation having a most material effect on its duration. From a quotation given above, we find that when the red clover was first introduced, it lasted for five years; and it is said that plants raised from seed grown in this country will last longer than those from seed imported from the Continent. It is seldom now that we can get it to grow longer than two years.

We have found it to flourish best in clay soils; the higher the state of fertility, the greater the chance of its succeeding. On the Continent strong clay soils are also considered the best adapted for its growth. Mr Stephens, in the *Book of the Farm*, says—"The soil best adapted for the red clover is deep sandy loam, which is favourable to its long tap-roots; but it will grow in any soil, provided it be dry. Marl, lime, or chalk is very congenial to clover." We have seen it growing with luxuriance on nothing but a clay subsoil, on which some guano and seed had been scattered, and also the first year on a field from which the soil had been removed during the formation of a railway. In most cases, on particular soils, it flourishes best when first introduced. And it is, no doubt, more uncertain in its growth since the turnip and other green crops came to be so extensively cultivated. Indeed, we may almost state it as the rule, that red clover thrives best on the worst-farmed lands. We generally find it, too, most luxuriant in those parts of a field which have been most poached by the horses' feet and heavy carting. And it is considered more likely to succeed when sown after barley which succeeds a turnip crop eaten off by sheep, than if the turnips had been all carted off.

Manure also appears to have a material influence on its growth. We remember seeing a field on which the manure had been carted out during a frost, and laid in heaps, which were not spread at the time. The frost was succeeded by very wet weather, so that it was impossible for any one to work out for some weeks. The best part of the manure was therefore washed into the soil under the heaps. When the field was in hay, there was scarcely a plant of clover to be seen in it, excepting where the heaps of manure had been allowed to remain unspread, where it flourished luxuriantly. It is found also that there is more chance of clover succeeding when the manure has been put on the land after the turnip crop, and immediately before the barley, than when, as it is generally done, applied before the turnips. The nearer the application of the manure to the clover crop, the more likely it is to succeed. And hence autumn-manuring for the turnip (whatever its advantages otherwise), unless followed by another application before the barley, is not the best practice for insuring a clover crop.

It has long been an agitated question, as to whether the grass seeds, and particularly clover, should be sown with a white crop. The ablest writers on agriculture have taken different sides. We think that the question is not difficult of solution; for, if we

consider the profits derived from the different crops, and other circumstances connected with them, we cannot fail to arrive at a correct conclusion. For instance, no farmer would sacrifice a white crop at present, merely for a slight additional profit in his pasture or hay, unless there were other circumstances connected with the latter different from the ordinary management of the farm. To meet with success in growing clover without a crop, it was recommended to sow it in autumn. When sown in spring, it was very apt to be choked with weeds, the seeds of which ripened, and were not easily eradicated; when sown in autumn, on the other hand, even though the weeds came up, winter arrived before their seeds ripened.

The crop after which the clover is found to succeed best is barley. Formerly it used to be sown amongst wheat in preference to any other, because in a dry season it was very apt to overpower the oats or barley. If sown with either of the latter crops, the operation was not performed till the cereal was 3 inches high, so as to give it a fair start in growing. The practice followed now of sowing the grass seeds immediately after those of the barley or oats, shows the change that has taken place in the vigour of growth of the clover. It was always found to succeed well after flax, as it does at the present day in Flanders, where, when sown amongst the flax, it is cut once the first year after the flax has been pulled.

On the first introduction of red clover, the facility with which it grew, and the extraordinary crops it yielded, soon established its character among farmers. But they were ere long compelled to lower their estimation of it; for after a few rotations, in each of which clover had a part, loud complaints were heard throughout the country of the fickleness of its growth. The land was said to have become "clover-sick," refusing any longer to grow the plant. Various reasons were given for this clover-sickness, which was manifested in different ways;—by the seed not germinating at all in the soil—or if it germinated, by the plant dying before the cereal crop, among which it was sown, was cut—or by its disappearing altogether from the soil before the growth of the succeeding spring arrived. Some alleged that the clover-sickness arose from the too frequent growth of the plant on the same soil; others, that it was caused either by the radicle excretions of the clover or other crop being inimical to its growth, or by the exhaustion of some of the constituents of the soil necessary for the growth of the clover; a third party attributed it to the want of consolidation in the soil—arguing that, as the introduction of clover and turnips were contemporaneous, and their cultivation made equal progress, the pulverisation of the soil necessary for the turnip was hurtful to the growth of clover.

These causes of clover-sickness refer to an alteration in the

chemical and mechanical constitution of the soil. There are other causes given for the failure of clover, to which we will shortly allude; but, in the mean time, we will limit our attention to these. We do not think that any one by itself can explain every case of the failure of clover. The first cause—the too frequent growth of the plant on the same soil—applies to other crops as well as clover. Indeed, the practice is at variance with the ordinary workings of nature; for there is no fact better established than that she rejoices in a change of crops, and we ought to follow her as closely as is consistent with our artificial system. Even in Belgium it has been found necessary to prevent the recurrence of the clover in the rotations oftener than once in every eight to twelve years. And in this country it is not now considered advisable to repeat it oftener than once in eight or nine years at soonest.

The second reason given is entirely a chemical one—viz., that the failure is caused by the radicle excretions of the clover or other plant being inimical to its growth, or by the exhaustion of some of the constituents of the soil necessary for the growth of clover. Now, we may state at once that science has done nothing here to assist the farmer in his difficulty; and those who attempt to explain every practical difficulty by scientific reasons, often bring science into discredit. The remarks of the late Professor Johnston are very pertinent here. "While," said he, "we avail ourselves of every resource which chemistry can present, either in explanation of the cause, or as a preventive of the recurrence of such failures, we shall only show our ignorance of other considerations which ought not to be forgotten, if we expect to cure every ailment in our crops by the aid of chemical science—assign, as some are ready to do, a chemical reason for every unfortunate occurrence in the growth of our crops—or demand, or lead others to hope for, a kind of benefit from chemistry, which it can never afford to practical agriculture." Liebig has tried to explain the failure of clover by the excrementitious theory: he says,—"The quickness with which the decay of the excrements of plants proceeds, depends on the composition of the soil, and on its greater or less porosity. It will take place very quickly in a calcareous soil; but it requires a longer time in heavy soils consisting of loam or clay. In some neighbourhoods clover will not thrive till the sixth year—in others not till the twelfth. This depends on the chemical nature of the soil; for it has been found by experience, that in those districts where the intervals at which the same plants can be cultivated with advantage are very long, the time cannot be shortened even by the use of the most powerful manures. The destruction of the peculiar excrements of one crop must have taken place before a new crop can be produced." That is to say, that as vegetable excrements decay more quickly in calcareous

than in clay soils, we will be able to grow clover more frequently in the former than in the latter. Now, this opinion is at variance with all experience; for those soils on which clover thrives best are our argillaceous ones, particularly our carse clays, where most luxuriant crops of it are raised, and where the farmers can with impunity repeat it oftenest. While, therefore, the chemical reason may be sufficient to account for clover-sickness in some cases, it will be found insufficient to explain it in most.

We think that there are more facts found supporting the mechanical theory—viz., that a certain amount of consolidation, cohesiveness, firmness in the soil, is necessary for the growth of clover. We have already alluded to some of these—viz., that clover thrives best in those parts of the field that have been most poached, such as the head-ridges; in those fields where the turnips have been eaten off by sheep; in clay soils; and that the pulverisation of the soil for green crops is not favourable to its growth. The principal advocate of this theory is the Rev. W. Thorp,* who attempts to prove that the absence of the proper mechanical condition of the soil—the want of compactness—is the cause of clover-sickness. Without committing ourselves to his views, we will give a short abstract of them. "Last winter" (1841), he says, "I took a great number of dying plants, at different periods of the winter, and examined them with the microscope, slices of whose stems and leaves were placed under a magnifying power of 100 to 150 diameters. The part first injured is the neck of the plant, about a quarter of an inch below the point where the leaves join the stem. If slices of the neck be placed under the microscope in the early stage of the injury, the sap-vessels are found simply ruptured; while, if the plant has been some time affected, as shown by its foliage, a dark spot will be seen in the centre of the stem, and the more external parts of a brown colour; and as the disease spreads upwards, the stem becomes black in its entire thickness, decomposition takes place, and the plant rots away a little below the base of the leaves. This destruction of the cellular tissue is owing to the *severity of the frost.*" Again, "The remote cause of injury by the frost is owing *to the want of a certain degree of cohesiveness of the particles of the soil* among themselves, and hence the soil's power of retaining heat is diminished; and those plants, particularly clovers, which are impatient of sudden change of temperature, are readily destroyed by the frost. And soils, by the growth of red clover, &c., become more pulverulent, puffy, and less cohesive, in proportion to the frequency of the growth of these crops; and this explains why these lands tire of clover." The appearances of the clover plants, and effects of the frost described above, are just what are observed on all plants that

* *Journal of the Royal Agricultural Society,* vol. iii.

have been injured by frost, not so much during winter as in early spring, when the alternations from cold to heat are far more sudden.

We are surprised that it never occurred to Mr Thorp that a weakness in the constitution of the plant may have had something to do with the failure. We have more than once seen a field of wheat sown in autumn with two parcels of seed of the same variety, but raised in different districts, presenting a most unexpected appearance in spring; for, while one part of it was most luxuriant, the plants from the other seed were more than half killed out. Now, this could arise from nothing else but a difference in the constitution of the plants raised from the two varieties of seed, for the field had been similarly treated in every way, and the sowing had been accomplished in one day.

But there is one case which occurs to us, which cannot be explained by the mechanical theory. Clover used to be sown in this country, and is sown in Belgium, amongst flax; and it is universally admitted that it succeeded best when thus treated. Now, surely the soil is more loosened by pulling the flax than by cutting the barley. The weeders, no doubt, during summer, may tread it more, but that can never compensate for the loosening it gets at harvest by the pulling of the flax. Besides, in Belgium there is no crop for which the soil receives such a thorough pulverising as flax; for besides a furrow in winter, it receives two, and several harrowings in spring. We believe that one reason of the clover succeeding better when sown with flax is, that from the habit of growth of the latter, there is both sufficient shelter and a free admission of air to the young clover plants; that this shelter is removed earlier, and when the weather is warmer, than when the clover has been sown among a cereal crop; and it is thus allowed to be established in its growth before winter. No one can deny that we have thus a hardier plant, one better able to withstand the severities of winter and the vicissitudes of spring.

Assuming, then, that one or other of the causes mentioned above, or a combination of them, will account for clover-sickness in the soil, we will proceed to mention some remedies for it. The first we would suggest is to alter the rotation, either by substituting another crop for the clover, or lengthening out the rotation. 1. When complaints were first made of the failure of clover, a remedy, which was tried and proved successful, was, where the four or five shift course was followed, to substitute pease for clover every alternate rotation. 2. And when turnips and potatoes came to be more extensively cultivated, and the clover failed in consequence, a practice adopted then, and which has been recently revived, was to apply manure to the white crop amongst which the clover was sown. 3. We are told by Mr Jackson, in his *Prize Essays*, that the soil of a farm near Edinburgh had become so "clover-sick"

that not only his clover crop, but his other crops, fell off so much, that, becoming disheartened, the tenant gave it up. It was taken by a flesher, with whom pasture was an object. Instead of following, therefore, the four-shift course, which was the rotation of the previous nineteen years, he allowed the fields to lie three or four years in pasture. The result was that the power of growing clover was completely restored to the soil, and his other crops were better than those raised by his predecessor, though a first-rate farmer. Pasturing, then, for three or four years, has in this instance, as it has in many others, been successful in restoring the growth of red clover. A modification of this system has been followed with success by some farmers. They sow red clover and no white in a field which is intended to be cut for hay in one rotation; in the next, that field is pastured for two, three, or four years, white and no red clover being sown in it.

We have hitherto recommended as remedies, changes in the systems of cultivation of red clover. We will now advert to several others, depending either upon the applications of different substances to the soil, or on the consolidation of the soil itself. 4. Rolling clover-sown lands, both in autumn and early in spring, has been found to be most beneficial; or the treading of the soil with sheep in autumn, in pasturing on the young clover plants, has been followed with good results, when the plants were not too closely cropped.

5. The success of the application of lime, chalk, marl, clay, gypsum, depends on the nature and composition both of the soil and of the substance applied. Lime cannot be recommended as a never-failing remedy for clover-sickness; but still, where it is deficient in the soil, its application has been attended with marked success in favouring the growth of clover more than almost any other crop, and imparting a sweetness to the herbage. Chalk appears to some an enigma, for, while clover refuses to grow on certain chalk soils, its application to soils of another description has been always found to be a remedy for "clover-sickness." We will probably be able to solve the difficulty here by taking into account the difference of texture of the soils. The use of marl in agriculture is of ancient date; and to it some of the best-farmed counties in England are indebted for their excellent crops of the present day. Its action as a remedy for clover-sickness is both mechanical and chemical—mechanical, from the clay which it contains—chemical, from the calcareous matter which enters into its composition. It was such a favourite manure with farmers long ago, and its application was so extensive, that through time it became positively injurious, both in exhausting the soil and in rendering it too stiff in several parts for the cultivation of some crops, so that it was brought very much into disrepute, and the use of it has been discontinued for some time in particular districts.

The practice of claying soils has also been long and extensively followed in England. The action is very similar to that of marl, but depending more upon its mechanical composition. The quantity used is from sixty to one hundred loads per acre, the load containing about thirty-two bushels. The expense of claying very poor soils is at least equal to the fee-simple of the soil. With good management, its effect is found to last twenty years. "In many cases," says Arthur Young, "a course of fallow and rye or light oats is converted into fine barley, clover, and wheat, and the produce of the soil multiplied twenty-fold; but, on the contrary, the cases in which the return has been inadequate are not a few." The claying of light soils has invariably been found to be favourable to the growth of clover. Gypsum has for the most part proved inefficient in improving the growth of clover in Scotland, while in England it is most extensively, and often successfully, used as a top-dressing for that crop. Any one, therefore, desirous of using it, should first ascertain by a small experiment its effects on his farm, before applying it to any great extent.

But there are other causes of the failure of clover besides clover-sickness in the soil. Of these we will mention first, bad seed. The practice of "doctoring" clover-seeds was carried to such a fearful extent some years ago, as to be made a subject of inquiry before a Committee of the House of Commons. White clover seed was first wet, and then exposed to the fumes of burning sulphur; while the bright blue colour of the red variety was improved by being shaken in a bag with indigo, or "with a preparation of logwood tinctured with a little copperas, and sometimes with verdigris." Not only was old seed improved in appearance by these means, but often the germinating power of the best seed was completely destroyed. From 6 to 8 lb. of seed will generally be found enough to sow, mixed with rye-grass, if the seed was good; but as we are quite uncertain of what we are purchasing, we would recommend a much larger quantity to be sown. Some have recommended as much as 24 lb.; while others, amongst whom are some of the best farmers in the Lothians, never sow less than 16 lb., either of red clover alone, or mixed with white and yellow. White clover should never be sown in fields intended to be cut for hay, nor red in fields intended to remain in pasture, more than one year. We should never forget the principal use of red clover, either as green fodder for cattle, or for hay; and in our endeavours to produce a heavy crop, we should guard against raising a coarse plant. Our object will be best attained here by having as many plants as possible; for the thicker the plants, the finer will be the stems: while a plant here and there will be sure to produce a coarse woody stem, which is never so well relished by animals; and hence the great advantage of thick-seeding.

A second cause of the failure of red clover we will mention is

the slug, *limax agrestis*. It attacks the clover plant both on its first brairding, and in spring after it has survived the winter. "It hybernates under loose clods, and in cavities about the roots of plants; but a few mild days will reanimate it, so that it is seldom at rest except during severe frosts." The remedy for it is heavy rolling immediately after it is discovered, or top-dressing the field with hot lime.

Parasitical plants are also a cause of the failure of clover. Fortunately we know nothing of their ravages in Scotland, but in some counties in England the clover has been destroyed by a parasite called the *Cuscuta trifollii*, or clover dodder. As the seed is often imported mixed with clover seed from Holland and other places, there is no saying when our fields may become infested with it. We will, therefore, give the following description of the plant, and the manner of its growth, as detailed by Professor Lindley, so that it may be recognised when it makes its appearance. "The cuscuta or dodder is a genus of leafless vegetable parasites, maintaining its existence by twining round other plants, into whose stems it inserts its sucker-like roots, destroying them by appropriating to itself the sap which was intended for their own use. In appearance the dodder is like a number of fleshy threads twisted round a branch; or it may be compared to long worms, or even to small animal intestines, whence has come one of its vulgar names—*devil's guts*. Here and there, on such threads will be found minute scales, and eventually clusters of small delicate globular white or pink flowers." "As soon as the seed of the dodder is ripe it falls to the ground, and usually seems to lie dormant till the succeeding year; sometimes, however, it is said to germinate immediately. When the spring returns, the embryo seeds are sent down into the earth to form a root, and with the other it rises upwards, like a small white thread or worm. At this time it is not a parasite, but seems to derive its food from the soil like ordinary plants. It cannot do so long, but withers and perishes, unless it touches some living branch or stem. If it succeed in doing so, it immediately seizes the live stem by means of a sucker which is protruded from the point of contact, and then twining from left to right, and forming more suckers as it twines, it establishes itself on its victim, and ceases to have any further connection with the soil. After making a few turns round the branch, and securing itself firmly in its new position, it again lengthens and catches hold of some other branch; and thus it goes on branching and twining, and sucking and branching again. Now the dodder has a new and independent seat of life wherever it has twined round a branch, and as it is incessantly twining and separating again, a single plant is speedily in the condition of a polype, so that if it be cut into a thousand pieces, each piece will immediately go on growing, as if nothing had happened to it." "The best plan of killing it is to dig up the crop where the dodder

appears, so as to form a circle considerably beyond the patch apparently formed by it, and then to burn the crop along with the pared soil." *

Another parasite infecting the clover plant, particularly in Belgium, is the broom rape (*Orobanche minor*), which Sir W. Hooker informs us is abundant in clover fields in Norfolk, Kent, Surrey, and Brecknockshire. "The minute seeds of this plant fix themselves to the roots of the clover, and vegetate at their expense. The plant affected becomes weak, and ultimately dies away, and the orobanche spreads so rapidly, that whole fields of clover are soon destroyed if the progress of it be not arrested in time. The only sure remedy is to keep the land in good tillage, and not to sow clover in it again for at least eight or ten years. If it be sown sooner, the orobanche will again make its appearance." †

We have now glanced at the principal causes of the failure of red clover, and at the remedies which have proved effectual for it. We are of those who feel sanguine as to the renewed vigour of the plant, if proper seed be used, and one or more of the restorative means alluded to above be applied. One or two experiments may be necessary to prove what is best to be done on a field or farm where the failure has taken place. But surely a plant on which hinges the modern system of cultivation, and on the successful growth of which the other crops of the rotation so much depend, from the mass of vegetable matter it lays up in the soil, is worthy of some little trouble from the farmer. For it must not be forgotten that, though we have found a very good forage-plant in the Italian rye-grass, it leaves the land in a very different condition from red clover. We are not, then, surprised at the enthusiasm which the Abbé Rozier manifested on concluding his article on *Trefoil* in the *Cours D'Agriculture.* He congratulated himself in having induced several individuals to cultivate it. "May their example," he wrote, "be followed from one place to another, and may cultivators be assured of its value. I would then forget all the trouble which the *Cours D'Agriculture* has cost me, and I would have the satisfaction of being able to say, that I have been useful to my country. I would die content."

* MORTON'S *Cyclopædia of Agriculture.*
† *Flemish Husbandry* (*Library of Useful Knowledge*).

AGRICULTURE, AS REPRESENTED IN THE FRENCH EXHIBITION.

Already the Great Exhibitions of London and Paris have become matters of history. For a brief period they astonished and delighted the world, and then disappeared. Brevity of duration is indeed implied in the very nature of these exhibitions. It is essential to their splendour, their opulence, and even, in no small degree, to their usefulness. Objects of value and magnificence may for a while be lent, which cannot be permanently alienated. Even crown jewels are occasionally needed for the purposes implied in their name. Efforts out of the ordinary course may be made for a short period in a manufacturing country, which, if prolonged, would interfere too much with the current of ordinary industry. Co-operation for one object between many different nations, and many different classes in the same nation, is all the more cordial and energetic because it is temporary. Curiosity and excitement, which brought such multitudes under the influences of these exhibitions, and thereby extended their utility, are in themselves transitory emotions, and never would have reached any height if there had been room for the conviction that they could be gratified at any time. Permanency, indeed, in any considerable degree, would have entirely altered the nature of these exhibitions. One of their most marked, characteristic, and valuable features would have speedily disappeared. They would have soon ceased to represent the actually existing state of things. Instead of reflecting the present, they would have been changed into memorials of the past. Instead of an exhibition, we should have had a museum—a collection of objects which, in regard to all the industrial and progressive arts, have a continual tendency to become obsolete. It is in keeping, therefore, with the novel character and object of these remarkable undertakings, that they should have been shortlived; that, as they may be said to have started at once into full maturity, without any preliminary process of youth and adolescence, they should in like manner vanish from the scene before showing any symptoms of decrepitude or old age.

But though themselves thus transitory, their consequences and effects will be permanent, and, we doubt not, permanently beneficial. It is, however, only in certain respects that these effects will become speedily apparent. They will perhaps be most valuable where they are most latent. The humanising influences of such exhibitions—the prejudices they dissipate—the catholicity of spirit they inspire—the expansion of thought, improvement of taste, and general elevation of the whole mind in many of the best elements of civilisation, which they tend to produce—form a kind of education of slow and silent growth, scarcely, perhaps, sensible to the individual under its influence. Other effects will be more immediate

and obvious, and cannot fail to be of great importance to the progress of the arts, and various kinds of industrial pursuits.

Of the latter description is agriculture, which can scarcely fail to receive important benefits, in nearly all its departments, from the comparison of the productions of different countries, the breeds of cattle for which they are celebrated, the machinery and processes employed in different places. In the French Exhibition this department has been well represented, and France herself will be the first to reap advantages from the exertions she has made and the expenditure incurred to attain this object. Her agriculture is in that state which, while it urgently needs, is at the same time eminently fitted to benefit by a general impulse. She is just beginning to be fully alive to the extent of her own internal resources, to her great capabilities as a corn-producing country; and no better plan could have been devised for suggesting the best means by which these might be developed, than collecting within her territory the best examples from every country of agricultural eminence, that she might examine them at leisure, and determine what was best fitted for her special purposes. It is judiciously remarked by Professor Wilson, that, "although all comers were welcomed by the Imperial decree, which freed them from any charges while within the territories of France, and notwithstanding that the scale of rewards was far beyond what has been deemed encouragement in this or any other country, there is but little doubt that this offering on the shrine of agriculture was conceived in the true interests of France, and that her soil will soon show how judiciously the expenditure was incurred. The conception was a compliment to the agriculture of foreign lands—the realisation of it a great lesson, and a boon to France. A living *Book of the Farm* was opened on a scale, and under conditions, such as had never occurred before. Each country had sent her best, and these all [he is speaking of the cattle show] stood together within the same wide area, models of their respective races,—standards of comparison by which the farmers of France could estimate the native breeds, or stocks from which they could draw supplies, either to improve or to replace any that were found deficient."*

It will tend greatly to extend and perpetuate the advantages of these exhibitions, to be furnished with judicious accounts of them by men of practical experience, and who have had extensive opportunities of observation. For this reason we receive with much satisfaction a series of papers on the agricultural contents of the French Exhibition, in the *Revue des Deux Mondes*, from the able pen of M. Leonce de Lavergne.† This writer is already most

* *Lecture on the Agriculture of the French Exhibition.* By JOHN WILSON, F.R.S.E., Professor of Agriculture in the University of Edinburgh. Page 30.

† *Agriculture, Agricultural Productions and Machinery, at the Great Exhibition.* By LEONCE DE LAVERGNE. *Revue des Deux Mondes.* Paris, 1855.

favourably known to British agriculturists by his spirited and intelligent review of the Agriculture of Britain and Ireland, of which an English translation was published not long since, under the title of *Rural Economy of England, Scotland, and Ireland.* He has likewise furnished accounts to his countrymen of our British agricultural shows, and is therefore familiar with such subjects as he has here undertaken to describe. He supplies much interesting information respecting the state of agriculture in many foreign countries, and more especially regarding its present condition and future prospects in France. He writes in a liberal and independent spirit, suggests much matter worthy of reflection, and discusses the subject with that liveliness of fancy, wide range of knowledge, and piquancy of language, which were conspicuous in his former works. In these circumstances, we do not think that we can do our readers a greater service than by laying before them the most instructive portions of M. de Lavergne's papers, suggested by the agricultural contents of the French Exhibition; and this we shall do, for the most part, by translating his own words.

There are two important departments in which the agriculture of France is eminently defective—these are draining, and the use of special manures. Without the former, indeed, which we are accustomed to regard as the foundation of all sound husbandry, the latter could not be expected to produce their full effects; and this, in connection with their expense, has probably caused them to be comparatively disregarded. The necessity of drainage is now, however, becoming generally appreciated, and the practice has in some places commenced on a considerable scale.

"The Marquis of Bryas (Gironde)," says M. de Lavergne, "and Viscount de Rougé (Aisne), have each exhibited a specimen of drainage. Both, in fact, have carried out extensive works of this nature. These two testimonies, from opposite ends of France, together with contributions of tiles and drain-making implements from several other quarters, show that drainage is now naturalised with us. It might have been thought that this English invention would be less applicable in the south than in the north; but it is proved to the contrary in the case of the Marquis of Bryas and of his neighbour, Count Duchâtel, who has drained his Medoc vineyard with great success. Drainage, which dries wet land, has the property also of moistening dry land, by drawing the surface-water to depths which prevent its rapid evaporation under a hot sun. This unlooked-for fact is now demonstrated. Besides, clay and impervious soils are to be met with as frequently in the south as in the north, and present there almost the same inconveniences which our cultivators attempt to remedy by means of ditches (*des labours en billons*), and by carrying the earth from the sides to the centre of the field.

"It is only in the richest departments of France, as the Seine-

et-Marne, Oise, Aisne, Seine-et-Oise, &c., that drainage is making real progress. Notwithstanding the repeated encouragement offered by Government, the rest of the country is doing little in it. It is a very expensive undertaking, and although it may be considered generally as an investment at 10 per cent, everybody has not £4 an acre to lay out. Great difficulties, too, stand in the way of its execution. Draining, in fact, is an art by itself. A knowledge of engineering is requisite for superintending the work, and special labourers for executing it. The manufacture of tiles is still imperfect, and it is not certain if in some places they will not be obliged to do the work over again. I have seen in England many fields which had to be drained twice or three times, either because the tiles were bad, or because they had been badly laid. We in France are not rich enough for such expensive schooling.

"With badly-worked and badly-manured fields, as is still the case with three-fourths of France, drainage can produce but little good effect. Great progress has to be made in most districts before that. The adoption of a good rotation costs less, and may prove as productive. Then comes the employment of some improved implements, as a good plough, a good harrow, thrashing by machinery, and the use of improvers for the soil. The imperfect means of draining which we possess may answer so long as the soil is not raised to a superior state of fertility—so much the more reason, therefore, is there for improving these, and extending them without much expense. That drainage forms only part of a combination of means for transforming, from top to bottom, a backward land, I quite understand; but in that case one must not talk of £4 per acre only, but must lay his account with £8 and even £15. So long as it has not come to this—and how many proprietors are there among us who are doing it?—it is better to proceed step by step, employing the small means while waiting upon the greater.

"There is, after all, a most serious obstacle, which the new law for compelling the proprietor of lower grounds to give passage, under indemnity, to the superabundant water of higher lands, has a little mitigated; but the difficulty has not been removed: I allude to the parcelling out of a portion of the soil. This parcelling has two forms, the one where advantages balance the inconveniences—small property; the other, which is attended with scarcely other than bad effects—small allotments (*la division parcellaire*). Neither are absolutely incompatible with drainage, but they greatly complicate the question, especially the last. When, in order to lay down a line of drains, it is necessary to pass through fifty allotments, belonging to different proprietors, all more or less running into one another, it becomes a heavy business even with the new law. It will be got over, no doubt, in time: the benefits of good draining are such as to triumph by degrees over all oppositions.

Only let us recollect that the difficulties exist, and not be surprised when we find that draining does not extend more rapidly."

Till very recently, the demand for guano in France has been quite inconsiderable. It appears from a return made to Government, that in the first six months of 1854, out of 225,000 tons exported from the Chincha Islands, 113,000 went to England, 98,000 to the United States, and only 5688 to France. This indifference to the most active and valuable of commercial manures is, however, rapidly disappearing; and there is every likelihood that it will come into general request. The demand for 1855 amounted to 100,000 tons. Yet, while neglecting the real guano, the French have been occasionally employed in manufacturing artificial manures, and claim the merit of being the first to conceive the notion of making "fish guano." "This novel manure," says M. de Lavergne, "figures at the Exhibition, and merits every attention from cultivators. It is one of the most prolific (*féconde*) ideas. Fish-manure costs a little less than Peruvian guano, and, in a manner, can be produced to any extent." As this substance has excited some interest in this country, we may state, from Professor Wilson's pamphlet, the mode of preparing it. "The fish—either the refuse of the market or otherwise—is cut into pieces, and submitted to the action of high-pressure steam (four or five atmospheres) for about an hour in suitable vessels. It is by that time sufficiently cooked, and is then ready for the presses, which expel a great proportion of the water, and leave the residue in the form of a cake. This cake is, by means of a coarse rasp or grating-machine, broken up into a sort of pulp, which is spread out in thin layers on canvass, and dried by means of warm currents of air. It is sold either in this state, or more minutely divided by means of the ordinary grinding processes. It is stated in this condition to correspond to 22 per cent of the crude weight of the fish, and to contain from 10 to 12 per cent of nitrogen, and from 16 to 22 per cent of phosphate. The price was 20 francs per 100 kilogrammes (about £8 per ton), and the demand regularly increasing."—(Page 5.) It is to be regretted that we have no accounts of the effect of this manure on the crops as compared with guano; but, judging from its composition, and the well-known value of fish in its natural state when applied to the land, it may be presumed to be of considerable efficacy; and if this be the case, there is surely no place where its manufacture could be carried on more advantageously than along the coasts of our own islands.

The agricultural products of Britain were very sparingly represented in the French Exhibition. They consisted only of a single collection, the chief merit of preparing and arranging which is due to Professor Wilson. But although so limited in extent, the individual articles were excellent in themselves and admirably

arranged, and they are spoken of in terms of high commendation in the *Handbook of the Imperial Commission* and the *Conservatoire des Arts et Métiers*. The following are M. de Lavergne's observations upon this collection, which, though somewhat lengthy, we are unwilling to abridge:—

"To give all their due, we shall commence with the agricultural productions of England. The space allotted to them is small, and draws little observation. One's attention is first attracted by enormous cheeses and gigantic hams; and these are articles upon which the English do not understand a joke, having very properly a national pride in them. There is nothing better than the Gloucester cheeses and the Yorkshire hams; and, in order to judge of their quantity, it is only necessary to see one of those English provision-shops, where they truly form mountains, imparting a comfortable satisfaction to passers-by. Their other animals are represented by heads of cattle ranged upon the walls, belonging to the principal breeds of England and Scotland—short-horns, Herefords, and Angus; and by pictures of sheep, such as one could never have credited, had the living models themselves not been seen this very year at the Cattle Show. I rather wonder that they have omitted to exhibit, in addition, the model of some colossal "roast beef," or half a roast sheep, such as appear upon the tables of the aristocracy, and especially upon the Queen's table at Christmas. It was thus of old, in the *Iliad*, they estimated the importance of the chiefs by the size of the portions they cut to themselves in the carving of entire carcasses of oxen.

"A complete collection of their wools proves, that if for the sake of the meat the English have given up the production of fine wool, they have at least, in the number and size of their animals, kept up the quantity. Most of their breeds have, besides, the special property of being what are termed long-wools.

"Their collection of cultivated plants has been arranged by Mr Wilson, formerly Director of the Royal Agricultural College of Cirencester, and now Professor of Agriculture at the Edinburgh University, in the room of the celebrated David Low, who retired last year. For want of space, the collection is not a large one—not nearly equal in extent to that of the Messrs Lawson at London in 1851, which contained not less than 400 varieties of cereals—but this one suffices. The principal kinds of wheat, barley, and oats cultivated in the United Kingdom are systematically arranged, and represented by bunches of ears and samples of the grain; also forage plants and roots. A ticket bears the name of the place where each sample was grown, the quantity of seed per bushel and produce per acre, with the weight. They come mostly from the neighbourhood of Edinburgh, where, in fact, the best crops in Great Britain are to be found.

"Botanists characterise seven different species of wheat, four of

which are of a superior kind—the common wheat (*Triticum sativum*), the fat or pullet (*T. turgidum*), hard wheat (*T. durum*), and spelt (*T. spelta*). The English grow neither the hard nor the spelt. The former thrives only in the more southerly regions, the latter is cultivated only in Switzerland and Germany. Of the two remaining, the *T. sativum* and the *T. turgidum*, the principal English and Scotch varieties of these are now well known in France as more productive than our own, and are being more and more adopted by the best cultivators of Flanders and Picardy. Among others, I may mention a kind of pullet called common rivet, which, upon suitably prepared soils, yields generally 30 to 40 bushels per acre.

"One of the most marked signs of bad farming is indifference to the quality of seed. It is in the vegetable as in the animal kingdom—if much depends upon attention to health and good food, care in the proper selection of breeding stock is no less important. When damaged seed is sown, if it be mixed with foreign substances and parasitical seeds, or if it be imperfectly matured and degenerate, a deficient harvest must naturally be expected. But when, on the contrary, superior kinds of carefully assorted, clean, healthy, and vigorous seed is used, the benefit is a hundred-fold. The production and sale of good seed forms a trade of itself, as the article, from special attention being directed to it, is improved. The more advanced farming is in a country, the more profitable will be its trade in seed-corn.

"It is true, this year's experience has been unfortunate for corn of English origin, which was being tried in the north of France. The severity of the winter, which exceeded that of England, destroyed it by frost. This is one proof among a thousand of the necessity for extreme caution in every agricultural importation, but no reason why the principle should be doubted. Let us endeavour to render these varieties less susceptible of injury from cold, and let us select those among our own which are most productive: all means are useful which tend to the desired object. In certain parts of France, whilst wheat yields 6 or 7 bushels per acre, or only threefold, a proprietor in the neighbourhood of Dunkirk, M. Vandercolme, exhibits this year a wheat, sent to him from Australia, which yielded him 70 bushels per acre, or tenfold. However extraordinary this return, it does not appear at all improbable when one considers the growth of wheat. This grain, of a very productive variety, and under most favourable conditions, has been known to produce 100 heads of 100 pickles each, or 10,000 pickles in all. Pliny speaks of a sheaf sent to Augustus containing 400 stems from a single root.

"The English varieties of oats and barley present similar characteristics. A sample of oats exhibited, of *Tartary white*, gave 85 bushels per acre. All these plants are remarkable for the

strength and size of the straw, as well as for the beauty of the ear. It is a matter of regret that the roots also were not exhibited; it would have shown our farmers to what a depth these go in a properly worked soil.

"Among the forage-plant seeds, the first in importance is the Italian ryegrass—*Lolium Italicum.* This plant is getting more and more into favour in England and Scotland, and increasing wonders are related of it. It is asserted that it can be cut six times a-year, each crop measuring 4 feet in height, making 24 feet in all. At an agricultural meeting, Mr Caird, author of the *Agricultural Letters* published in the *Times*, having asserted that, at Myre Mill farm, Italian ryegrass had yielded 25 tons of dry hay per Scotch acre, the thing, even in England, was looked upon as an impossibility, until, upon inquiry, it was found that, if not quite exact, the assertion was not very much over the mark. That there may be a little high colouring in all this is quite possible; but for the English and Scotch, who are such a matter-of-fact people, to put themselves into raptures about the thing as they do, proves that there must be a great deal of truth in these statements. We may add that, for the attaining of these great results, it is necessary to water with liquid manure.

"This ryegrass leaves all other forage plants far behind. However, as it cannot be cultivated everywhere, we find other plants in the collection less fastidious, and which still compose the greater portion of the English pastures, natural as well as artificial. Such, for example, are the clover, so much esteemed that Ireland has adopted it as her emblem; the ordinary ryegrass—*Lolium perenne*—which makes the famous English turf, and is surpassed only by its Italian brother; Timothy-grass, called in France *fléole des prés*, *fiorin*, or *Agrostis stolonifere*, &c., spreading from the root *agrestis.* These no doubt are all only hay, and the wonder is, that in an exhibition of industrial marvels, the English should have thought of giving a place to these humble herbs, which we trample under foot; but it is just these herbs which grow everywhere, and are found mingled with others which are useless or hurtful, which they have selected, assorted, invigorated, and transformed by cultivation. This hay is to them meat, wool, milk, manure, corn, and consequently population and power.

"Turnips, potatoes, beans, and a few field-beet, complete the series. And is this all? It is. No industrial plant? Not one; neither the sugar-beet nor tobacco—not even rape. They scarcely manage to have a few hops; and they leave to Ireland the monopoly of flax. Nothing diverts them from their favourite alternate crops, which tends to increase to an indefinite extent the production of meat and corn, and which they pursue with that fixedness of purpose which characterises the race."

The agricultural products of France, as might be expected,

appeared to great advantage on this occasion, great exertions having evidently been made that every article of value should be represented, and displayed in the most attractive form. And here it seems important to give greater prominence and generality of application to a remark made by M. de Lavergne, in the following extract, in reference to France. The extent and brilliancy of display made by any particular country, on such an occasion as this, must not be regarded of itself as a test of its agricultural progress, or even as a satisfactory proof of its agricultural capabilities. Crops of difficult culture, and of the finest quality, may be reared in certain favoured localities in a country which is quite incapable of producing them on a scale of any extent; and even this may be attained only by an exertion of care, and at an expense, which forbid the idea of them ever becoming objects of agriculture, properly so called. These, in fact, form, as M. de Lavergne truly remarks, the exceptional cases. We could rear vines in England, and Indian-corn even in Scotland, in sufficient perfection to make a respectable appearance at an exhibition; but no one would attempt, from that circumstance, to represent these as capable of being introduced among the staple productions of the country. Such limited products—quite sufficient to answer the purposes of an exhibition—are the result of a species of horticulture rather than of agriculture; and they are calculated to prove deceptive as to the state and capabilities of a country, unless we connect them with statistical details, and make ourselves acquainted with the circumstances under which they were produced. These remarks apply to certain other countries perhaps even more forcibly than to France.

"The exhibition of French agricultural products presents quite a different appearance from that of Britain. Here, on the contrary, variety is the dominant feature;—wools, silks, grain, oil, wines, vegetábles, fruits, textile plants, dyes, saccharine matters—to continue the enumeration would be endless.

"Nothing shows the French genius in a more favourable light than an exhibition: there, in fact, the quantity of a commodity does not count, the quality and novelty are everything. The French Exhibition is vastly more brilliant than the English; unfortunately, however, all these fine appearances conceal an inferiority in natural wealth, because all these valuable commodities are only exceptions. To give an example: One of the finest collections is from the school farm of Paillerots, in the Lower Alps. Beside a valuable species of wheat called *touzelle blanche*, which gives probably the finest flour known, one sees magnificent specimens of vegetables and dried fruits, madder, oils, splendid cocoons (silk), liqueur wines—in fact, everything that betokens the richest cultivation. Yet the province from whence these wonderful productions come is the poorest in France, and one of the poorest in

Europe; one half of the land remains absolutely uncultivated, and the other half can scarcely maintain a scanty and diminishing population.

"After saying this, I readily acknowledge all the remarkable contests of our agricultural exhibition. With respect to the cereals, I have already alluded to M. Vandercolme, and could mention many others. From every part of France there have been sent specimens of wheat, barley, oats, maize, and even the most beautiful rice. The wools, silks, oils, and wines, deserve, for the most part, similar praise. Among the industrial crops, the beet occupies more than ever the first rank. Not sugar only, but also alchohol, is produced now from this valuable root, through the genius of our inventors; and it gives these valuable products, moreover, with scarcely any loss to its feeding purposes. After abstraction of the saccharine matter, the pulp is still available for the maintenance of a large number of cattle, and in this way gives back to the land most of the element it had abstracted.

"Our largest agricultural establishments are employed upon the beet. In the department of the Pas-de-Calais, one single farmer, M. Crespel de Lisse, grows 2500 acres of beetroot every year, feeds 1000 head of cattle upon the pulp, and in this way produces sufficient manure to grow upwards of 3000 quarters of corn: there is nothing of the kind in England upon such a large scale. In the department of the Oise, a company is established at Dresles, with a capital of £30,000, for carrying on a similar concern; last year they grew 1200 acres of beet from which they made sugar and alcohol, and with the pulp fed I do not know how many animals, harvested 1000 quarters of wheat, and after disbursements and receipts to the amount of several millions of francs, divided, as I have been told, 15 per cent upon the amount of the shares. The State has its share of these enormous productions, as an hectare (2½ acres) of beet pays to the revenue for duty upon the home-grown sugar nearly a thousand francs (£40); and yet sugar is lower in price than ever. Such are the wonders achieved by modern chemistry.

"And now for the reverse of the picture: beautiful as is this crop, it has narrow enough limits. At most it occupies one thousandth part of the soil, and may hardly be extended further. Hitherto it has not succeeded in the southern half of France; it answers only in the rich, fresh, (*fraiche*) deeply-cultivated lands. It requires enormous capital to begin with, and oftentimes to be renewed, for the establishing of sugar-houses and distilleries, and, what is still more serious, the outlet for the produce is not unlimited. It is only owing to the grape disease that beetroot spirit obtains favour; should the disease disappear, this branch of production will stand a chance at least of being seriously interfered with. As regards the sugar, there is no certainty that the price will not

still further decline, and it is not to be compared, for importance of consumption, to articles of food. The true object of agriculture —its secure basis—is the production of meat and bread.

"On the same grounds the other industrial crops are still more open to attack. Like others, I can admire those specimens of tobacco, flax, colza, and madder, but sometimes ask myself if the labour and manure expended on them might not be more usefully employed. Their chief fault is that of always drawing the attention of our cultivators to the exhausting rather than towards the fertilising crops. One could never suppose, in looking at all these valuable productions, that the country growing them has been suffering from a state of inveterate scarcity during the last three years, and that in ordinary harvests it can scarcely feed its own population, which is half as dense as that of England. Such, nevertheless, is the case. There are many things which go to cause this anomaly, and I may ask, is this taste for exceptional crops of no benefit? Less exclusive than the English, I readily admit these beautiful productions as the crowning point of a high state of agriculture. I would only wish to remind that they can be only incidental to it: the basis of farming lies elsewhere, and it is certain we must have neglected this, since we do not attain the object that it has in view.

"I have spoken of France immediately after Great Britain, having been led to do so from a feeling of nationality; "dear, dear land," as Shakespeare says. But in justice I should have put before ourselves those countries which, without quite coming up to England, are nevertheless superior to us. Belgium, Holland, Switzerland, Saxony, Lombardy, and Bohemia, form a group of 75,000,000 acres, which for production come very near to Great Britain. These have a population equal to an average of 40 to 100 acres, whilst ours is only 27. France in reality occupies only the third rank."

Of the countries just alluded to, Belgium, Holland, and Switzerland contributed but little to the Exhibition; but the two latter sent specimens of what they value most, their superb cattle. Saxony was represented by the most beautiful of her agricultural productions, fine wool from the famous Negretti breed. We scarcely expected that Italy would have held so respectable a rank as that which our author is disposed to assign to her; we cannot withhold his remarks on that country, the more especially as they admit of being comprised within a narrow space.

"Deducting Lombardy, the rest of Italy takes its place with France in the third rank. Upon some points of this peninsula, as the neighbourhood of Genoa, and the duchy of Lucca, cultivation has attained a high degree of perfection; upon others, as Sardinia and Sicily, it languishes in a sad degree. Upon the whole, the agricultural development may be pretty

much the same as with us, and the fixed population is more numerous. This is what remains to Italy of its ancient splendour. Had it not been for the Georgophile Academy of Florence, which has contributed a complete collection of the productions of Tuscany, Italian agriculture would have been unrepresented at the Exhibition; it present condition is, nevertheless, not to be despised, and although it may have nothing new to teach us, the name of Italy ought never to be passed over when the question is one of the progress (*œuvres*) of civilisation. It is not so long ago since Italian agriculture was the first in Europe. Châteauvieux and Sismondi have mentioned it in the most enthusiastic terms. Sismondi's picture of it, we now know, was highly coloured; he had taken one point, the valley of Rievoli, as a type of the whole country, and his hatred to the system of farming, regardless of expense (*à prix d'argent*), which prevailed in England, made him blind to the defects of the *métayage* practised in Tuscany. The publication of MM. Ridolfi, in the doings of the Georgophiles, leaves no doubt as to his mistakes. There remains, notwithstanding, much truth in what he has written; and if the adoption of the quadrennial rotation, the development of machinery, of chemistry and other sciences, as applied to agriculture, and the accumulation of capital, have ended in raising English agriculture to such a height; if France, during thirty years of peace and liberty, has made up for previous lost time, it is no less certain that Italy had the lead not only in the fifteenth and sixteenth centuries, but in times more recent. Neither must we forget that Lombardy, although detached by conquest, is naturally a part of the peninsula. France and Italy finish the series of countries tolerably well cultivated, and as the whole of their territory is not in an equal state of advance, the quota that they together contribute may be estimated at 100,000,000 of acres out of 250,000,000 in the whole of Europe, which produce pretty much what they ought to yield in the present state of agricultural knowledge."

From the countries that have been mentioned, we reach the other countries of Europe by a considerable descent, till we come to Turkey and Greece, which may be said to occupy the lowest grade of the agricultural scale. "Wherever a Turk sets his foot," says a Syriac proverb, "the land remains barren for a hundred years." Let us hope that a new era in her history will soon commence; and as her inhabitants have shown themselves able to cope with the most formidable in the arts of war, the time will soon come when their beautiful land,

Rent by no ravage save the gentle plough,

will afford them the opportunity of proving that they can rival the most industrious in the arts of peace. Our author's notice of Greece is quite pathetic.

"Poor and little Greece has offered its contingent; but unfortunately the finest part of her productions consists in their names—corn from Sparta, barley from Thebes, maize from Olympia, beans from Argos, pulse from Mantinea, madder from Skyro, almonds from Ægina, silk from Messina, tobacco from Epidaurus, raisins from Corinth, honey from Hymettus, Piræan wines and Athenian olives. It is impossible, while reading these names upon a humble ticket, not to feel their magical effect. The greater their past history, the more distressing does their present appear. A fragment scarcely detached from Turkey, Greece still bears the fatal impress of centuries of oppression. True, she has for some years enjoyed liberty; but what can a quarter of a century effect in the reparation of such a long period of depredations? Almost everywhere even the soil has been destroyed, and the bare rock exposed."

M. de Lavergne should have added that the honey of Mount Hymettus was pronounced by the jurors the best in the Exhibition—

And still its honied wealth Hymettus yields.

Could their decision be impartial? For our own part, we could not have trusted M. de Lavergne in the case. Under any other name it could not have been so sweet, for the imagination, which gives a bias to our judgment in so many things, would not then have been enlisted in its favour.

The display of agricultural implements was extensive, there being no fewer than about 350 exhibitors, and many of these contributing several different articles. They seem to have been of a very mixed character in point of merit; and although it would be scarce justifiable to say that there was nothing new to be seen, still there was nothing strikingly novel in principle, or likely to afford an important addition to our means of culture. Of all agricultural implements, we would naturally suppose the plough to have reached the greatest perfection; but so far is this from being the case, that we scarcely find two nations agreed as to what constitutes its most perfect form. It is often constructed in such a manner as to increase rather than diminish the required amount of manual labour; and in some parts of the Continent it seems to have changed its character but little since primitive times. There probably never can be produced a model plough, fitted for general, much less universal, adoption; it must ever vary, in accommodation to the varying habits of different people, and the varying character of different countries. Here it is pre-eminently true that whatever *is* is right; its existence may be assumed as a proof of its excellence, under the circumstances in which it is required to act; and hence it is that we shall probably long continue to witness implements of this kind, which deviate so widely from our received notions of mechanical propriety.

"Of all implements," says M. de Lavergne, "the most neces-

sary is the most difficult to perfect; there is not such a thing as a perfect plough, and it is very doubtful if it be possible to find one which shall satisfy every condition. However, as attempts have failed hitherto to find a substitute for this primitive implement, we must continue to use it, while we improve it as much as possible. All the ploughs were tried by the jury; those which did apparently the best work with the least draught were,—the English *Howard*, the American *Bingham*, the Belgian *Odeurs*, and the French *Frignon*. As the experiment showed no very marked superiority in any, it is probable that each nation will keep to its own. That which is defective and imperfect in the work of the plough has to be supplied by other implements; as scarifiers, diggers (*fouilleuars*), harrows, and rollers. For these the superiority of the English is incontestible. Nothing can match Garrett's *binease*, Coleman's weeder, and the Norwegian harrow and clod-crusher of Crosskill. These superior implements are now copied in France, as far as the high price of iron and the means of our cultivators admit."

The manner in which the practical trials of the different implements were conducted, was not in all cases of a very satisfactory character, and it was protracted and irregular. It is gratifying to know that the English ploughs sustained well their reputation, and in one point of view may be said to have increased it. The dynameter showed, that while it required only a force equal to 17·01 to turn over a certain quantity of earth in a certain time with the best English plough, it required a force of more than 27· to do the same work with the best French one, and 32·3 with the best Belgian plough. Many other ploughs were tested, some requiring a forçe of 60, 80, and indeed nearly 100, so that, practically, one horse with the English plough would be as efficient as four or five horses attached to some of the other ploughs.*

The grand problem of steam cultivation can scarcely be said to have made any further advance to solution by what appeared at this Exhibition. It is an object, however, which seems to be constantly kept in view by all parties, and there is no reason to despair of it being ultimately attained. M. de Lavergne is of opinion that no one has hitherto come nearer the mark than M. Guibal of Castres (Tarn), whose *defonceuse*, or deep-digger, has reappeared at the Exhibition. It is an enormous cast-iron roller, armed with slightly-curved iron teeth of about twelve inches in length, which act like a congeries of pickaxes. When tried before the jury, the *defonceuse* gave rise to considerable discussion: it requires a great amount of power, and its work did not appear to be very perfect. In the south, however, after repeated trials, the opinion of it is more and more favourable, and it deserves to be kept in view.

"The English straw-choppers and root-cutters," says M. de

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* WILSON'S *Lect.*, p. 8.

Lavergne, "have this year been beaten by those of Belgium and Baden. On the other hand, the English haymaker *(faneuse)* has gained universal applause. This beautiful machine turns over the hay of $2\frac{1}{2}$ acres per hour, and thus does the work of fifteen or twenty haymakers. The drain-tile machine of Whitehead maintains its superiority, and was one of the things which attracted most attention. An Austrian invention for separating maize from the husk *(égrenoir de maïs)* also received merited attention.

"Thrashing-machines have been long known in France; in many of our provinces no other method is followed. In Lorraine and Burgundy they are in use amongst the smallest cultivators, and they are beginning to adopt them also in the west. These unpretending machines, which cost from £12 to £20, to thrash about 5 bushels per hour, have scarcely dared to show themselves at the Exhibition; notwithstanding, they are the most numerous, and consequently the most useful instruments we have. True, they cannot stand comparison with the powerful engines of England and America. In the trial which came off at Trappes, it was Pitt's American machine which carried the day, thrashing and cleaning 40 bushels of corn in the hour, against the English machine by Clayton 22, and the French one of Duvoir 14 bushels. The low result obtained by the last is owing to the quantity of straw it manages, a qualification which has its value in the estimation of the farmers about Paris. It must certainly answer its purpose, since the manufacturer has already delivered nearly 900 of them.

"Here then we have the Americans already taking the lead for thrashing. Pitt's machine comes from Buffalo (New York State), a town with 50,000 inhabitants, which has sprung up within the last forty years. Highly successful as its performance appears to be, it has been surpassed in the United States. I do not know why we have not seen at the Exhibition the machine of Mr Moffat, agricultural implement maker of Piqua (Ohio), which was tried last year at Tiptree Hall, and which, we are told, thrashed and cleaned 74 bushels per hour; and what is more wonderful is, it requires, they say, only a 4-horse power, and costs without the engine only £45. We hope Mr Moffat will not disappoint us at next year's Exhibition."

Reaping-machines necessarily attracted much attention, and they appear to have given greater satisfaction than on many other similar occasions.

"The grand success of the present year," says our author, "the leading feature in this vast competition, open to the whole world, is the reaping-machine. There is now no longer any doubt that the instrument which is to save man the most toilsome of his labours is discovered, and has nearly reached its perfection. America again has the credit, if not of inventing, at all events of executing better than others this emancipating implement. I can-

not describe the feeling which came over me when I saw the corn fall and range itself in swathes as the machine went along. A man conveniently seated drives the horses which draw the machine. In some cases another man is employed to rake up the corn, but this interference is not necessary; and so in this instance, which did perfectly well without him. M'Cormick's machine from Chicago (Illinois) reaps 120 square yards per minute, or nearly an acre and half per hour. It is the best as well as the oldest, for it appeared at the Great Exhibition of 1851 in London, where at that time it presented some defects which have since been remedied. M'Cormick sells 2000 of these per annum, at £30 apiece. The town of Chicago, which sends us this happy revolution, was a desert fifteen years ago.

"France can claim some participation in the solution of this problem. Among the reaping-machines tried this year was one invented and manufactured in France by M. Cournier, a mechanist of St Romans (Isère). It possesses some defects, but these are of easy correction; but it has this advantage, that it is worked with one horse; and I have no doubt, with a tolerable demand for the article, that it could be supplied at the price of £20. What is such an expense compared to the fears, delays, vexations, and expenses which harvest-time involves? It may be contended that the idea did not suggest itself to M. Cournier until after the appearance of M'Cormack's and Bell's machines; but I may mention one thing which more clearly establishes a certain right of priority in our favour, which is, that a reaping-machine, very similar to the one in question, was invented and published ten years ago by M. Constant of Rebecque, a landed proprietor at Poligny (Jura), and brother of Benjamin Constant. I have considered it only fair to recall this circumstance, as people generally seem to be ignorant of it."

M. de Lavergne does not absolutely claim for America the invention of the reaping-machine, and we think that he might have hesitated a little before speaking of M'Cormick's instrument as if there were no competitor in the field worthy of being named with it. He is well aware of the fact that there is such a competitor, alleged, on the strongest grounds, to be of prior invention, and which has often carried off the palm in similar contests. We believe that the American machines appeared on the present occasion to very great advantage; but the few trials made are quite inadequate to secure for them the superiority here claimed. It is not above two years since M. de Lavergne made a comparison between Bell's and M'Cormick's machines in the following terms:—"Independently of its national origin, Bell's machine appears to possess a real superiority over its American rivals. Besides the driver to look after the horses, M'Cormick's machine requires a man to gather off with a rake the corn cut by the cutting apparatus, whilst in that of Bell's this work is done by the

machine itself. As to the accuracy of the work, it is said to be superior, and this is very necessary; for M'Cormick's machine, the only one I have seen working, left a good deal of straw, and often a good many ears of corn, on the ground." * But the jury on the agricultural implements of the Parisian Exhibition have not only assigned a superiority to M'Cormick's machine — as the trials, we doubt not, *in this instance*, warranted—but they have appended to the announcement of their award a declaration that it is the model after which all other reaping-machines have been constructed. They designate M'Cormick "the inventor of the reaping-machine which has operated best in all the trials, and which is the type after which all other reaping-machines have been made, with various modifications which have not altered the principle of the discovery." Such as are well acquainted with the history of this invention, as the readers of this Journal have had an opportunity to become, are not likely to acquiesce in the accuracy of this deliverance. It is not, however, our intention to enter into this question on the present occasion. Suffice it to say, that M'Cormick's first patent, as he himself states, was granted June 24, 1834: the Rev. Patrick Bell produced his reaper in 1826. Various accounts of the latter have appeared in this Journal; among others, one of great interest from the inventor's own pen. If the French jurors have been furnished with new evidence which has altered the complexion of the case, they will probably not withhold from the public the means of determining to whom the honour of this important invention rightfully belongs. Meanwhile, a simple assertion, even from a quarter so respectable, ought not to disturb the conviction, which was previously entertained on the subject.

Even if the reaping-machine were in a more efficient state than it is, France is not in a condition to derive from it its full benefit. Agriculture must have reached a considerable degree of advancement before it can be introduced with effect. Fields must be enlarged, the surface must be levelled, freed from stones and other obstructions. These are conditions which it will more readily meet with in Britain; and we have little doubt but that the machine will in time be improved to a much lighter and more manageable implement, and supersede any other means now employed in this country for cutting corn crops. Many other French reaping-machines, besides that mentioned by M. de Lavergne, are intended for one horse; but there are also several others designed to be put in motion by the hand. These are constructed on various principles, some of them with cutters like Bell's. It may be asserted of these hand-machines generally, that they do not execute more work than the common scythe, and in some cases not so much.

* See No. XLII. of this Journal (New Series), p. 165.

It is possible, however, that they may be rendered capable of performing their task with greater ease to the labourer; and these experiments are interesting as showing that the reaping-machine need not necessarily be the massive and ponderous structure which it is usually thought necessary to make it.

The manufacture of agricultural implements had evidently been making progress in France before the opening of the Exhibition, and it will no doubt now advance with accelerated speed. "There are 150 of our own exhibitors in this class," says M. de Lavergne, "and not nearly all our *ateliers* are represented. One of our oldest and most important factories, that which still goes by the name of Dombasle, has sent nothing; and a whole host of country cartwrights, who begin to make the improved implements very well, are also wanting. To make up for this, the agricultural schools of Grignon and Grand-Jouan, the school-farm of Mesnil-Saint-Firmin, the agricultural colony of Mettray, and the *ateliers* of our most celebrated constructors, have furnished a remarkable contingent. Notwithstanding these persevering efforts, the English and American machines still carry the day. The Belgians, too, with their agriculture more parcelled out than ours, have found means to surpass us in some respects. Among other nations, the famous Agricultural Institution of Hohenheim (Würtemberg) contributes a complete collection of its implements, which should give us some useful hints."

One important privilege is likely to be gained by such implements and machines as were successful in the competitions. The jury unanimously resolved to memorialise the Minister of Finance, that their importation should be permitted at a greatly reduced rate of duty. They may in this way obtain a monopoly of the market, to the exclusion, in some cases, of others superior to themselves, but which happened not to be exhibited. The great expense of English implements will be a serious obstacle to their extensive introduction into France; imperfect copies of them will be employed instead. Along with the highly-finished article necessary to do justice to the perfection of their workmanship, it would have better answered the requirements of the Continent, if specimens had been sent on which no more labour had been expended, and no more expensive material used, than was absolutely necessary to the efficiency of the implement. In this way both parties would have been benefited to a greater extent than they are now likely to be, and the beauty of our workmanship would, at the same time, have had an equal opportunity, as now, of asserting its pre-eminence.

It is impossible to reflect on the results of the comparative survey to which such exhibitions invite, and which, at the same time, they partly afford the means of enabling us to make, without being struck with the immense agricultural capabilities of Europe, and

her consequent power of supporting a vast increase of population. Her resources, over a great part of the Continent, are not only undeveloped, but they can scarcely be said, in many cases, to have been touched on; not only is the mine imperfectly wrought, it has scarcely been opened. "Europe itself," says M. de Lavergne, "could supply with the most common agricultural products five or six times the number of her present population. Taking the condition of Belgium and England at the present day as the maximum, the rest of Europe has an immense stride to mak ere it can come up to them. Italy and Germany might increase their population one-third; France might double hers; Spain, Portugal, Hungary, Poland, and Prussia, triple theirs; Turkey and Russia multiply theirs tenfold; and supposing, which is the case, that Belgium and England are still capable of progress, a far wider career lies open to the other countries."

Its agricultural career has almost yet to be entered upon. The most effective means of production are yet to be put in operation, and most of these are within its reach. A vast extent of territory, almost ready for the plough, lies hitherto untouched; an improved cultivation of that which has been already reclaimed; the applications of science; the resources of art; the results of experience, tested by those who have gone before in the same career of improvement;—such are the means of success, ample and certain, in a pursuit the most essential to the welfare of man. Why have they hitherto been so little available, and likely still to be turned to most inadequate account? Alas! it is another of the many instances in which man mars the plans of nature, and perverts the provision Providence has made for his comfort.

"It is not fertility that renders a country productive," says Montesquieu; "it is liberty!" A more striking proof of this assertion—a more instructive commentary on this text—could not be furnished than by an exhibition like this. Give us the political condition of a country, and we can without difficulty predicate the state of its agriculture. What nations enjoy the greatest amount of political liberty? If we say Great Britain and the United States, we find them also unsurpassed in agriculture. Look at the most despotic — there it makes no progress, and has often to struggle for existence. Russia seems to realise the definition of the author of the *Esprit des Lois*—"When the savages of Louisiana want fruit, they cut down the tree; this is the picture of despotism." And yet Southern Russia alone possesses a corn-rearing zone of such extent and fertility, that it could produce sufficient to feed the present population of all Europe!

One of the great obstacles to the advancement of Europe in agriculture, is deficiency of capital. This has lately been felt to a considerable extent in France; there the evil may be of a more temporary kind, but in many other places it will long continue to operate. "As for capital," says M. de Lavergne, "powerful

causes divert it in other directions at present. It is a fact patent to everybody, that, notwithstanding the dearness of agricultural produce, which one would suppose ought to give additional value to the soil, rents do not rise, and land does not sell better than heretofore. This remarkable fact is the evident sign that capital is being drawn away from land; ten years ago the case was entirely different, indicating another disposition. This disturbance will be only for a time, and is in a great measure attributable to artificial causes. Left to its free course, capital divides itself more equally among the different enterprises requiring it; it would not, at any rate, betake itself except where its employment is profitable; instead of that, however, we see it getting absorbed by a mass of unproductive schemes. When the natural course is again established, and the soil once more begins to receive its share of capital, France will not only produce what is necessary for her own subsistence, but considerably more. With her present population, and surrounded as she is by countries infinitely more densely populated—as England, Belgium, Holland, Switzerland, and Rhenish Germany, which, notwithstanding their excellent farming, do not supply enough for their own wants—her natural part is that of an exporting country. She would be so now, were it not for the causes which have interfered with her development."

Every advance made by our Continental neighbours will alter the relation in which we now stand towards them in agricultural matters. If they make rapid progress for some time to come, it is because they set out from a low starting-point, and have our experience to serve them as a guide. We have every motive to stimulate us to exertion, and as we cannot, like them, draw largely from new territory, it is the more necessary to make the most of what we already cultivate. The occurrence of new events demonstrates more and more the importance of agriculture, not only as a source of national wealth, but as it affects the character of our population. The tendency of towns to absorb the population of the country has of late been largely on the increase. If it be true, as Dr Gregory long since affirmed, that the inhabitants of towns would degenerate to excess if not recruited by occasional drafts from the country, the question may soon be asked, whence are they to be obtained? As it was by a rural population that the national character was mainly at first formed, so it is in them that it still essentially resides. It is to a "bold peasantry, their country's pride," that we must look as our chief resource in times of difficulty or exertion, such as the present war has entailed upon us. And if the production of food be the grand object of a nation's exertions, it well becomes us to use every effort to increase the natural tendency possessed by the rural life and occupations it requires, to preserve and improve the character of our people, and to be thankful that two objects of such importance are so compatible with each other.

THE FARMERS' NOTE-BOOK—NO. L.

The Nomenclature of Agricultural Science. By R. RUSSELL, Kilwhiss.—It is of much importance to the study of any science to have clear and definite conceptions of the meaning of the terms which are in common use among its teachers. There is necessarily little danger in giving an erroneous meaning to words which are strictly technical in any particular science or art, but there is not a little danger of causing confusion when common words are used in a technical sense, to which the plain English of these words is in a great measure opposed. This state of things should not be so; but we are afraid that the nomenclature of our agricultural science is by no means faultless in this respect.

Our readers are aware that a somewhat keen discussion has been going on for some time between the illustrious German, Baron Liebig, and several agricultural writers in Britain. A general opinion seems now to prevail that, from first to last, a great amount of misunderstanding has arisen from the use of vague and indefinite terms. For an example of the truth of this assertion, we have only to look at the different meanings which British writers attach to what they call the "mineral theory of the nutrition of plants." It is perhaps proper to observe that this is an English term which was not first used by the translators of Liebig's works. The same thing may be said of "mineral manures." Liebig did not apply this term to the manures which were manufactured under his name. This was also done for him by British writers. Had the language which has been used in controversy, on this and other subjects, been more precise, much of it certainly would never have occurred. Were we asked to point out the chief source of all this misunderstanding, we should certainly have no hesitation in pointing to the system which agricultural chemists have adopted of dividing the *constituents* of plants into two classes, *organic* and *inorganic.*

Oxygen, nitrogen, hydrogen, and carbon, are, as is well known, classed as "*organic constituents;*" while the alkaline and earthy bases are classed as "*inorganic constituents*" *!!*—phosphorus and sulphur usually among the latter. These last two, indeed, are reckoned as a sort of neutrals, apparently neither quite belonging to the organic nor inorganic world, because the test, by which the character of all the others has been determined, does not decide their real character. For it must be observed, that all those *constituents*, which disappear as an invisible gas on being subjected to a red heat, are reckoned as *organic!* those that are fixed and remain in the ash, as *inorganic.* We would simply ask, if anything could be better calculated to create a chaos in the mind of the student just entering upon the study of agricultural chemistry, than the above?

It is rather amusing to read the writings of British and American men of science on this point, and see how they gradually confound the boundaries between the organic and inorganic world. There is very little variety in the way in which each appears individually to reach the region of error. A young and talented friend, with whom I spent a very happy time beyond the Alleghanies last autumn, presented me with a copy of his *Elements of Agriculture*. I shall merely make an extract to show how much our own system of classification has been followed on the other side of the Atlantic.

"That part of a plant which burns away during combustion is called organic matter: the ashes are called inorganic matter. The organic matter has become air, and hence we conclude that it was originally obtained from the air. The inorganic matter has become earth, and was obtained from the soil.

"We know that plants consist of various substances, such as wood, gum, starch, oil, &c., and on examination we shall discover that these substances are composed of the various *organic* and *inorganic* ingredients already described."

Such a system of classification, I submit, is about as philosophical as if we were to say, that carbonate of lime is an inorganic substance composed of the inorganic element calcium, and the *organic* elements, carbon and oxygen. We must always bear in mind that the elements which enter into the composition of plants, like those which enter into the composition of a mineral, are united together in definite proportions, in conformity with Dalton's law of equivalents—viz. that the quantities of each must either be equal or multiples of each other.

In truth, then, all the elements found in plants obeying the law of equivalents are part of the living structure; and it can be said of them, that they are constituents of certain kinds of organic matter. But, on the other hand, we cannot say, with strict propriety, that the element, nitrogen, or any other element, is an organic element or constituent of plants. This would be equivalent to saying, that nitrogen is an *organic* constituent of organic matter. On the other hand, to write and talk about "*the inorganic constituents of plants*" is objectionable, because it implies that there are organic constituents, when, in reality, all are inorganic.

We shall first trace the source of this dividing of the constituents of plants into "organic" and "inorganic," and afterwards give some examples of the confusion to which it has very naturally led.

The translator of the first edition of Liebig's *Chemistry of Agriculture and Physiology*, does not use, I believe, the term "organic constituents of plants;" but in the second edition (p. 7), after describing carbon, nitrogen, hydrogen, and oxygen, as "the constituent elements of plants," concludes the first division of that chapter by the following paragraph:—

"It follows from the facts thus far detailed, that the development of a plant requires the presence, first, of substances containing carbon and nitrogen, and capable of yielding these elements to the growing organism; secondly, of water and its elements; and, lastly, *of a soil to furnish the inorganic matters which are likewise essential to vegetable life.*"

This would have been all quite right, if two letters had been added, to have made the reading "*other* inorganic matters which are *likewise* essential to vegetable life." But I consider that the frequent use afterwards of "inorganic constituents," in the elegant translation, is really a spot upon it. This trivial error has been greatly magnified by British agricultural chemists broadly dividing the constituents of plants into "organic" and "inorganic"!

In the fourth edition of Liebig's agricultural work, translated by Dr Gregory, there is a chapter devoted to the "inorganic constituents of plants," but there is nothing said about organic constituents. Curiously enough, however, carbonic acid, water, ammonia, and sulphates, are scarcely included among the inorganic constituents. Dr Gregory's translation of Liebig's last work, *Principles of Agricultural Chemistry*, makes no reference to inorganic constituents in contradistinction to other constituents. As will be afterwards shown, however, it contains an instance of the confusion which arises from such a system of classification of the constituents as is common among other writers.

The English translator of Boussingault's *Rural Economy*, it is worthy of observation, devotes a long chapter to "*the* inorganic matters contained in plants," and describes the substances found in ashes under this head. There is no mention of "organic constituents." The term "inorganic" has evidently been used instead of "mineral." The chapter has been improperly headed; for, with one exception perhaps, every sentence is correct, but it is surely most misleading to be told that "the inorganic substances contained in vegetables evidently come from the soil."

Thus, I fear, the translators of Liebig's agricultural works have not been entirely without blame in the misunderstanding which has existed for some time among agricultural writers. Had we definite conceptions of the meaning which we attach to inorganic and organic constituents, or to "inorganic and organic food" of plants, no great harm would be done. But the technical meaning is constantly mixed up and confounded with the plain English. Only let some of our agricultural writings be translated into a foreign language, and let the same again appear before us once more retranslated into English. The bad English will most likely be left behind in the process; but our meaning will assuredly be turned upside down. The great majority of the German writers are anti-Liebig in their doctrines; still, when we

look into their arguments, they do not seem to understand the points on which we are disputing: instance the case of M. Mohl, one of their most distinguished vegetable physiologists.

"Even if these experiments were still far from having decided the question of the necessity of organic food, in a definite manner, the results are so concordant with those of experience on a large scale, that there can be no doubt of their general correctness; the more that these experiments, made on the smallest scale, obtain a confirmation through the extraordinary small results which manuring with Liebig's *solely inorganic manures* has everywhere had, when comparative experiments have been made. Instead of reforming agriculture by his manures, Liebig has caused them to demonstrate the incorrectness of his theory of the nutrition of vegetables." —*Anatomy and Physiology of the Vegetable Cell*, page 80.

The fault of Liebig's "patent manures," as he called them, did not consist in being wholly composed of inorganic substances, but in not containing sufficient nitrogen for the crops to which they were applied. It is not difficult, however, to see that misconceptions might easily arise from the use of the term—the inorganic constituents of plants—when we have been describing the alkaline and earthy constituents of plants under that class. Our language has been literally translated; and while we have been classing ammonia as an *organic constituent* of manures, and as "organic food of plants"! need we wonder that foreigners cannot comprehend us?

Dr Wolff's writings furnish us with another example of the ambiguity which arises in the use of our current nomenclature. In the extract given from his writings in Liebig's *Principles*, we are quite at a loss to understand whether "organic" is used in the technical or literal sense. If one is pretty familiar with all the points in the discussion, he may guess at the meaning. An improvement is also made on the "mineral theory," and for the first time we are told that Liebig's theory was the "pure mineral theory."

"The exhaustion caused by the cultivation of different crops is in no way directly proportional to the quantity and quality of the organic and mineral constituents present in the crops; and further, that the pure mineral theory, founded and formerly defended by Liebig, has not been confirmed by the practical experience of agriculturists."—P. 122.

As I have already said, the term "mineral theory" is of British manufacture, and it was long used in this country by British writers before it was used by any of the translators of Liebig's works. The term is our own invention, and we have given our own meaning to it. This has actually been the case. In the same manner, Liebig's "patent manures" have been styled by us Lie-

big's "mineral manures;" and were considered as the natural offspring of the "mineral theory." I believe every purchaser of Liebig's "patent manures" was presented with a small pamphlet from the manufacturer, entitled, "An Address to the Agriculturists of Great Britain, explaining the Principles and Use of the Artificial Manures, by Professor Justus Liebig." This production contains some of the best thoughts of the illustrious German on the subject of manures. His manures, so far as we can gather from the explication of the principles upon which they were to be manufactured, were theoretically perfect; his prescriptions for all plants went even the length of making them entirely independent of a supply of ammonia from the atmosphere.

"All manure which is to be used during next winter contains a quantity of ammonia corresponding with the amount of nitrogen in the grain and crops which are to be grown. Experiments in which I am at present engaged will show whether in future times the cost of the manure can be greatly lessened by excluding the half or whole amount of ammonia. I believe that this can be accomplished for many plants, as for clover and very foliaceous vegetables, and for pease and beans; but my trials are not so far advanced as to prove the fact with certainty."

Who is the author of the terms "mineral manure" and "mineral theory" I do not know; but surely it was very unfair that, while some were occupied in refuting Liebig's theory of gypsum acting by fixing the ammonia in our dunghills and meadows, others were engaged in demonstrating that Liebig maintained that ammonia was of no use as a manure at all.

Without doubt, then, there has been much misunderstanding in the meaning which we have attached to our own term "mineral manure." Long before Liebig wrote his last work in vindication of his principles, I had openly maintained that they were entirely misunderstood by many writers of note. This the authors of the Rothamsted Papers must admit; and, further, that the parallelism between the arguments which I then used against the interpretation of the Rothamsted experiments and those which Liebig is now using,* is something more than merely accidental.

A perusal of the abstract of the Rothamsted Paper read before the British Association at Glasgow would furnish much matter for criticism. It has always appeared to me very curious why the opinions of Mr Lawes and Dr Gilbert, which rest a little beyond the mere dispute about the meaning which has been attached to certain terms and sentences, have never been made the subject of discussion. Do we not stand a little under Liebig's censure?—"Reflection is given over to the chemist." The science of agriculture is perfectly boundless; and if we have any doubts as to

* Professor Liebig's *Reply to his Reviewers*. Translated by S. W. Johnson, Country Gentleman. Albany, 1st Nov. 1855.

the soundness of any received opinions, it is right to express them freely.

We are still told by the authors of the Rothamsted Papers, that "the composition of agricultural vegetable produce is no direct guide in the choice of manures for the various crops grown in the rotation." But then we were formerly told that it was an indirect guide. On the platform on which Mr Lawes has always argued this question, I believe that the principles involved in this matter have about as much to do with chemistry as with mechanics. Mr Lawes now occupies himself in refuting Professor Way's silica theory of the loss of ammonia in cereal crops, while he leaves his former doctrines on this subject entirely out of view. I gave a simple explanation of this matter long ago, which applies equally to cereals and all other crops. *The waste of ammonia arises from imperfections in our methods of applying manures.* Can our agricultural societies not have the courage to discuss such questions? The Rothamsted experiments furnish unanswerable arguments for this simple view of the matter; and it is quite consistent with hundreds of other facts scattered over the broad fields of agriculture and of nature. Notwithstanding all that has been said to the contrary, Liebig's "patent manures" had, for one of their objects, the *saving of ammonia*, but not dispensing with it. And further, up to the present moment, Liebig has given a better explanation of the cause of wheat being more dependent on a supply of ammonia in the soil than the authors of the Rothamsted Papers.

I shall close this paper with a few remarks on a recent innovation in our nomenclature, which, I am afraid, is to pass into use without any discussion, and that assent to it, on the part of agriculturists, is to be given through their maintaining silence on the subject. I allude to the meaning which we have hitherto attached to the term "finger-and-toe" in turnips.

Professor Buckman, in the 15th vol. of the Transactions of the Royal Agricultural Society of England, has written an elaborate paper on this subject, and contends that the disease of "finger-and-toe" in turnips should be restricted to the degeneracy which takes place in turnips, when they grow coarse stems and branched roots. The same views have been maintained with great ability in some recent numbers of the *Agricultural Gazette* (November and December 1855). Mr Berkeley, a most profound writer on vegetable pathology, also adopts the same views in the *Gardeners' Chronicle* (8th December 1855), and maintains that a distinction should be drawn between the disease of "anbury" in turnips, and "finger-and-toe." But I do not hesitate to confess, that I cannot discover sufficient reasons for drawing any distinction between "finger-and-toe" and "anbury." Nay, I consider such a distinction is altogether uncalled for.

The causes of degeneracy in turnips have been very ingeniously

traced, both by Mr Buckman and Mr Berkeley. But no one, until now, I believe, ever thought of considering the tendency of the cultivated root to revert to its wild state, as a diseased condition of the turnip. The degeneracy of turnips was never confounded with the disease so well known under the not inappropriate name of "finger-and-toe." It is a great reflection upon the intelligence of the officers of the Highland Society, to suppose, as Professor Buckman has done, that they were analysing soils for the purpose of discovering the causes which produced degeneracy in their root crops. If the term *degeneracy* is not sufficient to express the reverting to wildness in our cultivated varieties of turnip, the term finger-and-toe, it appears to me, is exceedingly inappropriate.

Indeed, both the writers who are now contending for the restriction of the term "finger-and-toe," are obliged to admit that this degeneracy—this running wild of the cultivated varieties of turnips, is not a disease in the strict sense of the term. Why then call it a disease? Why call the tendency of certain plants to revert to their natural methods of growth a malady; a malady which can only be said to attain its worst stage when the plants are about to attain their most healthy or natural state, by entirely running wild?

But we are told that this degeneracy—"this malformation, is finger-and-toe, being merely a forked or *digitate* method of growth. Finger-and-toe is common to all root crops." It seems to me, however, that the use of the term digitate here, and in all Professor Buckman's writings on this question, is improper. In his paper in the *Royal Journal of Agriculture*, there is a drawing of one root, which is as like a hand with its five fingers as could be imagined, and which is described as digitate, and affected with the disease of "finger-and-toe." But, notwithstanding this, the root cannot be said to be either "digitate," or "fingered," or "toed" in the botanical sense of the term. It is forked or branched certainly. "A digitate root," says the *Imperial Dictionary*, "is one in which the *tubercles* are divided into *lobes like fingers*." Now, none of the degenerating roots which have been figured and described by Professor Buckman answer to this description; but, on the other hand, a turnip, attacked by anbury, often has its roots lobed by the formation of excrescences; in short, it is digitated or fingered-and-toed in the proper sense of the term. Therefore, to restrict the term of finger-and-toe to degeneracy of root crops seems to me totally inadmissible, from whatever position we may choose to look at the matter. And besides, were it adopted now, it would cause great confusion in all that has been formerly written and done in the matter. I think we should still adhere to the view which Mr Curtis has taken on this question in Morton's *Cyclopædia of Agriculture*, that "anbury is a disease in turnips sufficiently indicated by its other name of fingers and toes."

Thermometrographia for the Farmers' Year ending with October 1855. From observations at Annat Cottage, Perthshire; N. Lat. 56° 25′; Elevation, 170 feet.

The upper dark line shows the weekly mean temperature, and the lower, the weekly depth of rain. The degrees are marked on one side, and figures indicating inches for rain on the other side of the table. The dotted lines show the weekly mean temperature and depth of rain for the twelve months ending with October 1854. In that season the severest cold was in December and January, and the spring months were mild. Last season the first half of the regular winter season was mild, but winter was thrown into spring; and, as shown by the two lines, the weather was colder than in the previous year, from the second week of January till the middle of April, and then it was warmer for only two weeks, being colder during the whole of May. In the summer months there was little difference between the two years, and in both, the temperature in July and August exceeded the average; but last September was again cold as compared with the sunny and warm September of 1854. The week of most rain in 1854 was the last week in May; that week in 1855 had no rain at all; and, in consequence of continued drought at this time, hay was light, and oats and barley made a tardy starting, which resulted in shortness of straw in autumn. The ear of autumn-sown wheat was also shorter than it might have

been if the weather in May, when it was formed in embryo, had been moister and more genial. The rainiest week in 1855 was the first of August, a week in which none fell in the previous year. The rains consisted of heavy thunder-showers, and the rain-water ran off the soil without moistening it to any great depth; and at the end of August, though it had rained in that month to the very great depth of 6.78 inches, the subsoil was dry, and water springs were lower than is usual even after dry springs and summers. The depth of rain, with melted snow, for the first six months of 1855, was no more than 11.52 inches, or just about as much as fell in 1846 between the 19th of June and the end of July; and scarcely 4 inches more than fell in February alone in 1848. The heavy rains of last August had the effect of beating down corn very much without injuring the quality of the grain to any great extent; for the heavy showers in the latter part of the month, when harvest had commenced, were but of short continuance, and drying breezes always followed, preventing injury from sprouting, either in the sheaf, or where the uncut corn had been beaten down. The corn fields whitened very rapidly in August, and harvest was soon completed. In 1854 there was a very early spring, and also an early harvest; in 1855 the spring was very late—or rather winter took the place of spring—and yet the harvest was no later than in the previous year, and even on many farms it was a few days earlier. In the early part of January last the weather was mild, and certain winter flowers bloomed from ten days to a fortnight earlier than in the preceding winter. But the snowdrop in February was 21 days behind its date of 1854; and after this the difference between the seasons, as indicated by the blooming of flowers and leafing of trees, became still greater. Throughout March, April, and May 1855, vegetation was from 28 to 30 days behind 1854, but in the fourth week of June it had gained so much as to be only 5 days behind; this being shown by the time at which wheat began to put forth the ear. By the middle of August, as shown by the dates at which reaping commenced on certain farms, it was even a day or two in advance. All this shows that neither from the earliness nor the lateness of any spring can the earliness or lateness of the succeeding harvest be predicted.

There is a theory, to which allusion was made in the Journal for January 1855, and according to which mild winters succeed warm summers—the heat imparted to the soil in summer being given out gradually in course of the succeeding winter. In December 1854 the weather was very variable, frost and fresh alternating almost every second day. This showed that a counter-agent was at work. In the first week of January 1855 the weather was very mild, and it appeared as if the theory referred to was to be proved correct. But it seemed after this as if the heat imparted to the soil in the sunny summer and autumn of 1854

had at last been exhausted, and in February there was an unbroken time of severe frost. The counter-agent, whatever it was, seemed to have overborne all opposition. And whether or not it may be true that the cause of this severe frost—this spring of more than wintry severity—may be traced to a lessening of the force of the great Gulf Stream that brings the heated ocean waters of the West Indies to our northern latitudes—the lessening of this force again being traceable to a slackening of the trade winds of the torrid regions, or to some other cause affecting a "stream" rather than a "drift" current—we may rest satisfied that no one theory of the weather can stand every test, and that it is consequently in vain, by the aid of meteorological societies or otherwise, to aim at weather predictions. Whether theories of climate are founded on the earth itself, or find their place in the lunar sphere, or still farther away amongst the planets; it is still true that they are all liable to failure. There is a kind of weather wisdom that is uniformly correct in its conclusions; but it is beholden for this to rural experience, and not to astronomical or meteorological learning. It is the kind that has led to the employment of such unfailing local and rhyming adages as are common in Scotland, and of which the following, referring to the attraction of mist clouds by hills, is a specimen,—

> When Ruberslaw puts on his cowl, and Dunion on his hood,
> Then a' the wives in Teviotdale ken there will be a flood.

The severe frost of February last has had the effect of testing the fitness of certain exotic trees and shrubs for the climate of certain localities in Scotland. In some places, both in Scotland and England, trees of the Chili pine, Indian cedar, Lambert's cypress, and other kinds, were either injured or destroyed; but this was in localities, whether at low or high altitudes, where the soil and subsoil are cold and retentive, or where the natural conformation of the ground favours the settling down of hoar frosts. In other localities, such as that to which the above diagram refers, these trees were not in the least injured; but there the rocks are igneous, or of the lowest formation, the soil is dry and warm, and no hoar frost rests on the sloping surface. In some places the hardiest of our native shrubs suffered injury. It is nothing new to see the whin hurt by frost; but even heather on the hills was blasted, and the common holly, in more places than one, lost its leaves. This being the case, exotic shrubs and trees are not to be laid aside as unworthy of future culture, though they also had marks of the winter left upon them. The case was entirely exceptional. The climate for the time was not a British climate; for, if it had been so, these native plants would not have suffered.

Rested and rendered excitable, by means of the long winter and severe frost, deciduous trees, such as the elm, put forth very large

leaves in summer, and in June there was a remarkable suddenness in vegetable development. When autumn arrived, it was found that, short as the summer had been, the larch and other trees in young plantations had made shoots of greater length than usual.

The mean temperature for the twelve months was 46.69 degrees, being more than a degree under the average, and nearly two and a-half degrees under the mean for the previous twelve months. The season must therefore be called cold, although there was a warm July and an early harvest. And, although the total amount of rain exceeded an average depth by 4 or 5 inches, the season must still be called dry; for, of the 32.43 inches that fell, no less than 15.80 inches, or nearly one-half, belonged to the months of November, August, and October; and of this great depth for these three months, no less than 6.78 inches fell in August in heavy thunder-showers, which, after all, as has already been remarked, did not serve to moisten the soil deeply. As August adds its large amount of rain to that of the vegetating season, the total depth for that season, extending from March 20 to October 20, was 18.99 inches, or considerably more than fell in a whole year in 1826. As the heat of July made up for the cold of May, the mean temperature for the vegetating season was just about the average, having been 52.62 degrees. On September 24, the barometer indicated 30.332 inches at 170 feet; on January 9, it stood at 30.300 inches, and the next highest was on April 21, when it showed 30.245 inches. The lowest was on November 29, (1854) being 28.350 inches; on October 28 it was as low as 28.520 inches, and on March 12, 30.511 inches.

The farmers' year ending with October 1854 was, as shown by figures, the driest of the two, having had only 27.02 inches of rain; but the rains were differently and more beneficially distributed.

The season has presented another phase in the dubious history of the "potato disease." In most kinds of soil, potatoes could not swell from want of moisture, till thunder-showers fell in the end of July and beginning of August. From the second week of August till October, in which month there occurred a sharp frost, potatoes continued swelling, and at last they had attained a large size, and the produce was remarkably bulky. But fair as the tubers appeared when taken up, they were not well-ripened; for frost cut down the foliage while it was in a green state. The produce was so abundant, that farmers were fain to form the pits wide and high as in former years; and no doubt, heating in the pits, which would have occurred in any case, was encouraged by the immaturity of the tubers. In November, an alarm arose in the later parts of the country that potatoes were rotting rapidly in the pits; and while this has turned out to be true to a less or greater extent in all

districts, it is especially true on late, light, or poor soils, where the potatoes were worst ripened—where they did not swell at all till after Lammas—and where frost overtook them while still in a growing state. Thus, in the different years of its existence, the potato taint has been manifested in every kind of soil and climate, and in seasons of drought as well as seasons of moisture—in cold years and hot years.

The general belief this season is, that the potatoes suffered because they had to be taken up while unripened. But this was not of itself a sufficient cause; latent taint must have previously existed, although there was no appearance thereof at lifting time; and want of ripeness must have acted chiefly by an increase of perspiration, and consequent heating in the pits. Potatoes will keep quite well when taken up even so early as August, and while they are only half grown, if they are well stored, and are entirely free from disease, seen or hidden, when lifted.

One symptom of disease in the pits last November (for its progress was checked in December) was the springing of the eyes, and formation of shoots, as if it had been April. In many cases also, young potatoes were formed at the joints of these shoots, and at the eyes—the diseased tubers, as is common in the economy of vegetable life, expending their latest vital energies in attempting to propagate their kind. Farmers generally left the means of ventilation at the ridge of the pits, and some brought in fresh air from below, by means of rows of drain-tiles laid under the potatoes; but this free circulation of air seemed to hasten instead of retarding the progress of this unexplainable disease.

Insects injurious to Pine Trees. By DAVID GORRIE.—It is said that the common or "Hanoverian" rat first came to Britain in the ship that brought over the Elector of Hanover to reign in our island as George I. It has now, as Charles Waterton says, extirpated the original and comparatively harmless British rat, and has an unconquerable propensity for living at the public expense, and poking in its nose where it has no business. But the rat is not the only injurious creature that has come to Britain from Germany. Various insects have preceded it or followed in its path, though the year of their arrival cannot be so distinctly stated. The Hessian fly came in with German wheat, and of late years at least two German insects injurious to pine trees have appeared amongst us. The one is the caterpillar of the pine saw-fly, *Tenthredo pini*, or as some call it, *Lophyrus pini;* and the other a little black beetle called *Hylurgus piniperda*, of which Gyllenhal says, "Habitat in *Pini sylvestris* ramulis, quos perforat et exsiccat etiam in ligno et sub cortice frequens." But it does not confine itself to *Pinus sylvestris*, as the cultivators of exotic pines in Britain know this year. In a collection of pines in Annat Park, Perth-

shire, it has been very injurious to *Pinus excelsa* and *halepensis*, and has taken the other kinds, such as *cembra*, *Laricio*, *austriaca*, and *caramanica* in its way. The injury done has not been fatal to any of the trees, but has lessened their beauty and checked their growth for a season. These trees grow on "Loudon's Brae," a place which, because of certain trees wherewith its surface is varied, is associated with the much-respected name of the late Mr Loudon. The insect has been known in the neighbourhood of Edinburgh for some years.

Hitherto this insect has not in Britain, as it sometimes has in Germany, destroyed pine trees by the acre; but its increase with us in 1855, and especially the way in which it has attacked pine trees of great value as objects of rarity or ornament, may well cause arboriculturists to inquire whether or not there is any way of checking its ravages. In a pinetum, amongst young trees, much may be done for this end by cutting off and burning every shoot as it begins to wither. When it attacks large forests, as it has done in Germany, the plan recommended by Dr Rossmässler seems to be the only effectual one; and that is to cut down and burn every infected tree. There is no way of getting at the beetles in any wholesale way without cutting off the infected twigs or burning the whole tree, as each beetle is safe from ordinary agents in the hole that it has carved for itself in the young shoot or branch.

This beetle attacks the leading shoots of pine trees, commencing generally with the shoot of the current year, but also boring into the branch farther down, or into the wood of the previous season. In commencing its operations it drills a small round hole at the base of a pair of leaves, and then, turning upwards, forms a vertical tunnel of about an inch or more in length, and then escapes by piercing through again to the bark. Another tunnel may enter immediately above this, the whole of the current year's and the last year's shoots being perforated by a series of tunnels open at each end, and separated from one another by a small portion of solid wood; and the beetle that begins uppermost, or within an inch of the top, sometimes bores right up through the centre of the terminal bud. The young shoot when thus pierced withers and falls off, but the leaves of the older wood, being sustained by a hollow cylinder of bark and woody fibre, may continue green for a season. The insect may be called in plain language a little black beetle, about one-sixth of an inch in length, and more particularly a beetle of a cylindrical form, and black colour, varying to a dull buff or pitchy red, and with *lineate-punctate elytra*. In excavating, it reduces the wood to small dust by its strong mandibles; but of this dust, as Mr Curtis remarked a number of years ago, part consists of shapeless lumps, and the greater portion of very thin semi-transparent lamellæ, or

rather shavings. Besides boring the leading shoots, the insect sometimes injures the wood and bark of the trunk. Several other species of *Hylurgus* have been found at work in the pine forests of Germany, namely, *ligniperda*, *ater*, *palliatus*, and *angustatus*. The species *Piniperda* has been found in Norway spruce trees, as well as in pines proper. The generic name applied by some is *Hylesinus*.

It was long ago found in Germany that the race of pine-bark beetles, to which the genus *Hylurgus* belongs, increased most in warm dry summers, followed by cold and dry winters. These terms describe the summer of 1854, and the winter that followed it; and *H. Piniperda* did some harm in Perthshire in 1854, though not nearly to such a great extent as in the following year. "Hot weather," Kollar remarks, "shortens the period of transformation, and thus, by affording time for the maturation of several broods, causes a superabundant number of insects to be found." The common kinds of bark beetles lodge in the bark of the trees and bore into the stems. *H. Piniperda*, though it lodges in the young shoots, lays its eggs under the bark of sickly and felled pines and spruces, the maggot living in the bark and feeding on the stagnated and fermented juice under it. Hence the advisability of carting away and burning decayed trees in order to destroy the maggots, or to prevent the beetles from finding suitable breeding places, though indeed they will deposit their eggs under the bark of healthy trees if they can find no other. The natural enemies of all the pine-bark beetles, including the genera *Hylurgus* (or *Hylesinus*) and *Bostrischus*, are burrowing wasps, ants, and several kinds of birds. Certain birds, such as the woodpecker, finch, and tomtit not only eat the maggots, but are still more fond of the beetles themselves. All these natural enemies of the beetles and their larvæ should be encouraged by the forester—the gamekeeper being forbidden to molest them. Felled trees that cannot be removed, should have their bark stripped off, and burned whenever it is found, in course of the summer months, to contain beetles or broods of maggots. It would be well if all felling of firs were completed, and the woodlands cleared of the felled trees, before summer sets in every year; and if fir trees lying in summer at the sawpit were examined, and the bark taken off and burned, if found to contain the insects. Rustic railings of unbarked fir or larch poles may afford them breeding-places—for the larch also has its bark beetle. It has been found that larch does not thrive after Scots fir, and that Scots fir itself does not grow freely on the site of old fir-woods. The "exhaustion" theory of rotations, and also the theory of Decandolle, which explains the necessity of rotations, by the polluting effects of matter deposited by roots, may both be brought forward to explain this, and in both there may be truth; but doubtless a change in the kinds of trees planted is also

commendable, on account of certain kinds of insects breeding about places where trees of the kinds they affect have long grown.

The pine saw-fly, *Tenthredo* (or *Lophyrus*) *pini*, injures pines by feeding on their leaves when in the caterpillar state. About thirteen years ago it stripped the branches of several pines at a place in Perthshire, and has occasionally appeared since, though not in great numbers. It seems to prefer *Pinus sylvestris*, *pumilio*, and their kindred species, but will not refuse the finer leaves of such pines as *excelsa* when put upon them. When tried upon *Abies morinda*, the caterpillars seemed to be much put about by the sharpness of the short and stiff foliage, which prevented them from moving about freely. The female fly slits the pine leaf with her ovipositor, and inserts her eggs in the incision. The caterpillars, which are fully an inch in length, appear towards the end of summer. Both fly and caterpillar are fully described in Kollar's *Treatise on Insects*, and the insect is described as being very injurious in the German forests, sometimes stripping trees entirely of their leaves, and causing their speedy decay. Each female fly lays one hundred eggs, so that the increase of the insect would be enormous, were it not for two natural checks. One of these consists of cold and wet weather, which destroys the caterpillars when they are young, or when they are changing their skin; the other is weather of such a favourable character as tends to the increase of their enemies, the ichneumon flies. The birds most commended for destroying the caterpillars are the green woodpecker, the great red, or various-coloured woodpecker, the black woodpecker, and the nut-hatch. The squirrel (which our gamekeepers shoot remorselessly) hunts them on the trees of Germany, and the field-mouse devours them as they fall to the ground.

Hitherto the few that have occasionally appeared in Britain might easily have been shaken off the branches and destroyed, or the branches themselves cut off and burned. It will be a sad day for our pinetums if ever it be necessary to cut trenches in the ground to catch the caterpillars as they march in millions, like locusts, from one forest to another. And yet it will only be after considerable evil has been done (if ever it be done) that means of prevention will be generally resorted to—such as shaking the young trees in the mornings when the caterpillars are stiff and easily shaken off, or destroying the pupæ, by carrying away and burning or fermenting in a manure-heap all the moss and dry leaves found in fir plantations in winter, and, of course, the dormant insects at the same time. And yet, where the caterpillar has appeared, it might be well to adopt such measures, and also to scrape the bark so as to remove pupæ from its rents and fissures; and even to surround the trees with mounds of sand about eighteen inches high, so that the larvæ may be stifled in attempting to escape from the stem where they may have been bred. This is one of

the many plans adopted in Germany. It may be hoped that the climate of Britain will, in general, prove unfavourable to any great increase of these insects.

*Stephens' Catechism of Practical Agriculture.**—The literature of agriculture is now assuming, in this country, a highly respectable character. It was long in arrear of our practice, for those who excelled most in the practical operations of the field, long continued unwilling, as they were for the most part unqualified, to take up the pen for the purpose of instructing others. Those, on the other hand, who wrote on the subject, were generally deficient in practical knowledge; hence their views were mostly of a theoretical or speculative kind, and seldom productive of much benefit to the art. It may now safely be affirmed that our agricultural publications are not only keeping pace with our practice, but reacting upon it, and aiding greatly in the general improvement. The systems of agriculture which have lately appeared, must not only tend to render the general practice more uniform and consistent, but to make recent improvements known in the remotest districts, where otherwise we could scarcely expect them to be speedily introduced.

And not only are the landmarks of the art thus advanced, it is gratifying to find that works are likewise making their appearance, calculated to diffuse a more correct knowledge of its principles among all classes directly connected with it. The work now before us—a Catechism of Practical Agriculture—is eminently of this character, while it contains information useful to all engaged in the ordinary labours of husbandry; it comes down to the level of the merest tyro, and affords him an elementary view of the whole subject, which even the dullest intellect can scarcely fail to understand. Indeed, of the numerous elementary works of this nature, in different departments of knowledge, which we have lately had occasion to examine, this seems the best calculated to attain its object. The general arrangement is simple and natural, and brings the different operations of the farm successively under the notice of the reader, in the order in which they actually occur. The questions bring out all the particulars most essential to be known, and the answers are short, precise, and easy to be remembered. It is only by a writer long accustomed to reflect on the subject, and intimately acquainted with its details, that so much information could be conveyed in so condensed, and, at the same time, so clear and intelligible a form. The language is remarkably simple and perspicuous, and even those least experienced in deriving information from books, can scarcely ever be at a loss as to the precise

* *Catechism of Practical Agriculture.* By HENRY STEPHENS, F.R.S.E., Author of the *Book of the Farm.* W. Blackwood & Sons, Edinburgh and London.

meaning. The work is profusely illustrated with cuts, not only representing groups of figures engaged in farming operations, but domestic animals, and most of the implements used for cultivating the ground, and preparing the grain. These cuts, along with the accompanying descriptions, render the names and uses of the different parts readily understood, and cannot fail to impress them on the memory. Of these illustrations it is only necessary to say that they are executed in the same style as those of the *Book of the Farm*, at once elegant and accurate.

Although, for the object in view, the work had necessarily to be of limited extent, no important branch of the subject is omitted. Besides the ordinary operations of the farm in their due sequence according to the seasons, an appendix includes all that does not form an integral part of the ordinary course, and such works as are performed at particular periods of a lease, and in particular states of a farm, which do not usually require to be repeated. We have thus a complete epitome of an agricultural system, according to the method which experience and science have sanctioned as the best.

When this subject is introduced into schools, as we have little doubt it soon will be, it is satisfactory to know that we are now provided with such excellent manuals as this, and Professor Johnston's similar work on agricultural chemistry, to which it may be regarded as a fitting companion. It may, perhaps, be doubted whether the catechetical form is best adapted to those who study the elements of the subject by themselves. It involves certain inconveniences, and, unless very skilfully managed, does not present the subject in that strict continuity and mutual dependence of parts which contribute so much to the comprehensive understanding of it as a whole. But there can be no doubt that this method of treating it affords great facilities to a teacher, particularly to the teacher of a class; and it has the advantage of eliciting a distinct and explicit deliverance on all the main points, which is well adapted for fixing itself in the memory. Viewed as an educational work, we consider this little volume of Mr Stephens' as of high value, and as constituting an additional claim on the gratitude of the public for the great services he has rendered to practical agriculture. And while thus fitted to benefit the more youthful of our rural population, it will be perused with pleasure and profit by their seniors, as often suggesting improved methods of management, assigning sound reasons for what they have been accustomed to do from mere traditionary usage, and making them acquainted with the results of a more extensive knowledge and experience than they have had the means of acquiring.

"Should this little work," says the author, "find its way into the public schools of the country, teachers might extend the questions largely on every subject treated of, and introduce others on a few subordinate subjects which have been purposely omitted in

order to retain the work within reasonable compass. Some acquaintance with practical agriculture would easily enable them to originate questions. It might also be advisable to exhibit working specimens of hand-implements, and show the manner of using them. Other machines than those figured might be traced with chalk upon a black board, and their superiority or inferiority to the machines given pointed out. Drawings of the cultivated plants in their different states of growth, and of the varieties of live-stock usually reared, might be placed before pupils with much advantage. Samples, too, of the various grains and seeds sown on farms would at once impress upon the memory of the pupils their identity and use.

"By means of such a course of tuition in the school, and exemplified on the neighbouring farms, the occupants of which would doubtless be willing to second the views of the teachers, a large amount of correct agricultural knowledge would be imparted to young boys and girls destined to earn their livelihood on farms, and which at present is only attainable by labour in the fields, to the serious neglect of other kinds of knowledge only to be acquired at school. Thus, by combining a professional with the usual education to young farm-labourers of both sexes, a larger portion of their time might be spent at school than there is, greatly to their own advantage in mental culture, and to that of their masters as securing servants of a superior capacity."

THE LATE PROFESSOR JOHNSTON.

By a Scottish Farmer.

Our readers will already be apprised of the melancholy death of Professor Johnston, which took place at Durham on the 18th of September last. We embrace the first opportunity afforded us of paying a passing tribute to the memory of one who has enriched the pages both of this *Journal* and of the *Transactions of the Highland Society* with his contributions. We are sure that we will meet with the sympathy of all lovers of scientific agriculture, in our expressions of grief at the loss of one of its principal promoters.

A Scotchman by birth and parentage, Johnston received that solid education usually given to the children of the middle classes in his native country. We are not aware that he manifested any predilection for the natural sciences before he went to Glasgow University to prosecute his studies; where, after his attendance at the chemical class, he resolved to devote his attention more

particularly to chemistry. With this view, after grounding himself in his favourite science, he went to Sweden, and studied under the celebrated Berzelius. The years immediately succeeding his return to this country, and after his appointment to the office of Reader in Chemistry and Mineralogy in the University of Durham, were devoted to investigations in the laboratory, which he prosecuted with the greatest ardour. The results of his labours were, at this time, confined to valuable communications to the British Association, and interesting articles in some of the principal scientific periodicals of the day; so that his name was comparatively unknown, save to a limited circle of men of science.

Scientific agriculture, with which his name is now principally associated, did not appear to have occupied much of his attention till 1841, after the first part of Liebig's brilliant report upon the state of Organic Chemistry had been laid before the "British Association for the Advancement of Science." Occupying a high position in science, he, nevertheless, devoted his talents and energies to explaining to farmers the scientific principles of their profession. His *Lectures on Agricultural Chemistry and Geology*, addressed to practical agriculturists, bear testimony to the great success which attended his attempts to make everything plain to his hearers and readers; for "everything," he said, "in such lectures, which is not, or may not be easily understood by those to whom they are addressed, is worse than useless." And yet these lectures, addressed to a non-scientific audience, form one of the standard works in agricultural science. Not content with teaching the fathers the hidden truths of his favourite studies, he addressed himself to the children also, and used his utmost endeavours to have a class established in our parochial and other schools, for teaching the elements of agricultural chemistry, and, with this view, published his *Catechism of Agricultural Chemistry and Geology*, which has been of immense benefit to more than teachers and scholars. Its wide circulation has been evidenced by the publication of nearly forty editions.

His mind and pen were ever active to keep pace with the rapid progress of agriculture, and from time to time, important elementary and other works were issued by him, bringing before the farmer the latest discoveries in the science of his profession. Among these works we may particularise his *Elements of Agricultural Chemistry and Geology*, which has already reached a sixth edition, and is mainly an abridgment of his lectures, with the subject still more popularly treated. His *Experimental Agriculture* is an admirable digest of all the published agricultural facts at the time; and though the suggestions for future experiments therein offered have been considered by some practical men as comparatively worthless, from their having failed when tried, we ought not to forget, in judging of them, that the facts at his command were

comparatively few, and that, probably, the experiments suggested were tried under circumstances totally different from those on which he founded his opinions. His work *On the Use of Lime in Agriculture* brings before us all that is known on that important subject, displaying that searching diligence for which he was distinguished, and the power he possessed of explaining the simplest facts by a reference to scientific principles. And we must not omit to mention his *Contributions to Scientific Agriculture*, which is a collection of the very valuable and interesting papers which were published by him when Chemist to the Agricultural Chemical Association of Scotland.

He accepted an invitation to deliver a course of lectures in North America; and on his return he published the results of his observations. As was to be expected from his powers of observation, his extensive scientific acquirements, his knowledge of the applications of science to agriculture, and his clear and attractive style, his *Notes on North America* forms one of the best books on that country, and is alike interesting and instructive to the general reader, and most useful to the emigrant.

Were we to attempt to characterise the lectures and writings of Professor Johnston, we would say that they were eminently suggestive. He carried his hearers and readers to the very verge of known truths, to the *ultima Thule* of well-ascertained facts; but he did not leave them there—he showed them what they might expect to find beyond, and suggested how they might discover it. We have often thought that it was owing to this—a power of inspiring hopes in his readers and hearers—a most invaluable quality in a lecturer or writer—that some practical men were apt to consider him too theoretical in his suggestions and advices. But this was a mistake, arising very often from a misapprehension of his meaning—a want of discriminating between what he said *would* happen, and what *might* happen. We believe that, carried away sometimes in conversation by an enthusiasm in his studies, he did make statements to which few practical men would subscribe; but such were sedulously avoided in his lectures and works. We are certain of this, that there was none more conversant with the mass of agricultural facts published, and none who subjected these to a more rigid examination and comparison, than Professor Johnston. We will not extend this sketch by any laudatory expressions of ours. His works bear testimony of what he has done for science, for the instruction of the people, and for agriculture; the last of which, in particular, is deeply indebted to him for his valuable services,—services which will be ever more highly appreciated and acknowledged the more advanced the state of agriculture becomes.

AVERAGE PRICE OF THE DIFFERENT KINDS OF GRAIN,

PER IMPERIAL QUARTER, SOLD AT THE FOLLOWING PLACES.

LONDON.

Date.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Sept. 1.	77 6	33 6	26 6	44 6	42 4	44 1
8.	78 1	34 0	28 3	50 4	38 10	43 10
15.	80 0	34 4	29 10	51 0	46 11	44 5
22.	82 6	37 0	28 2	51 3	43 6	46 5
29.	80 8	36 9	28 7	52 0	42 4	46 2
Oct. 6.	80 0	40 1	28 9	54 11	50 7	49 7
13.	80 3	40 2	30 4	52 4	55 4	47 1
20.	79 11	40 10	28 6	51 8	51 7	49 8
27.	84 8	40 8	32 1	51 10	54 1	54 8
Nov. 3.	83 8	40 9	26 9	52 5	55 5	51 4
10.	83 7	40 4	26 11	52 2	53 11	50 7
17.	84 5	41 3	28 1	54 0	54 2	49 7
24.	86 11	42 6	27 1	53 4	50 0	49 11

EDINBURGH.

Date.	Wheat.	Barley.	Oats.	Pease.	Beans.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.
Sept. 5.	81 1	38 1	33 10	50 0	51 1
12.	85 2	38 4	33 5	51 6	52 2
19.	79 4	39 1	34 2	49 8	50 4
26.	79 1	39 10	34 7	50 8	52 2
Oct. 3.	80 6	41 0	35 5	53 6	53 9
10.	82 6	41 2	36 4	52 8	53 3
17.	87 8	43 1	35 7	51 2	51 9
24.	86 7	44 3	35 11	54 2	56 0
31.	84 1	42 11	33 1	52 9	53 10
Nov. 7.	86 1	42 7	31 0	53 10	54 11
14.	84 7	43 3	32 0	51 9	52 4
21.	83 8	44 0	32 1	53 2	55 0
28.	81 6	43 7	32 4	52 2	53 0

LIVERPOOL.

Date.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Sept. 1.	76 6	34 2	27 1	42 4	40 10	51 2
8.	78 0	34 7	27 4	39 10	39 6	51 6
15.	76 4	34 10	30 8	40 4	39 10	51 2
22.	78 9	35 3	28 7	40 6	40 8	51 4
29.	76 8	36 6	31 9	38 4	41 6	50 6
Oct. 6.	75 9	36 8	29 6	37 1	41 10	49 8
13.	76 4	34 6	29 1	39 0	42 8	54 0
20.	75 2	33 10	27 10	38 4	44 3	52 4
27.	77 10	40 8	27 2	39 2	46 8	51 0
Nov. 3.	76 2	37 9	28 9	40 4	50 2	50 2
10.	77 0	38 3	27 1	42 6	54 11	55 10
17.	78 4	38 5	28 6	43 8	50 10	52 5
24.	76 11	40 1	29 4	44 6	52 6	57 6

DUBLIN.

Date.	Wheat, p. barl. 20 st.	Barley, p. barl. 16 st.	Bere, p. barl. 17 st.	Oats, p. barl. 14 st.	Flour, p. barl. 9 st.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.
Sept. 7.	42 4	18 6	15 5	16 7	26 6
14.	42 7	19 0	16 2	17 0	26 8
21.	42 1	19 2	16 3	16 2	26 7
8.	41 11	20 0	16 8	15 6	23 8
Oct. 5.	41 3	20 9	16 4	15 2	26 6
12.	41 11	20 2	16 6	15 4	26 7
19.	42 5	20 8	16 9	15 6	26 8
26.	42 1	20 5	16 6	15 0	26 7
Nov. 2.	43 6	21 4	16 10	15 2	26 10
9.	44 6	23 2	17 6	15 9	27 4
16.	45 8	24 6	18 4	16 6	27 8
23.	46 0	24 11	18 10	16 11	28 2
30.	46 2	24 4	18 8	16 7	29 0

TABLE SHOWING THE WEEKLY AVERAGE PRICE OF GRAIN,

Made up in terms of 7th and 8th Geo. IV., c. 58, and 9th and 10th Vict., c. 22. On and after 1st *February* 1849, *the Duty payable on FOREIGN CORN imported is* 1s. *per quarter, and on Flour or Meal* $4\frac{1}{2}$d. *for every cwt.*

Date.	Wheat. Weekly Average.	Wheat. Aggregate Average.	Barley. Weekly Average.	Barley. Aggregate Average.	Oats. Weekly Average.	Oats. Aggregate Average.	Rye. Weekly Average.	Rye. Aggregate Average.	Pease. Weekly Average.	Pease. Aggregate Average.	Beans. Weekly Average.	Beans. Aggregate Average.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Sept. 1.	73 7	76 6	34 5	34 7	27 6	28 8	43 6	44 8	40 0	42 5	46 4	46 7
8.	74 10	75 5	35 0	34 8	28 2	28 8	43 11	44 5	39 4	41 2	47 10	46 11
15.	76 9	75 2	35 3	34 9	28 6	28 7	45 3	44 1	43 5	41 4	48 0	47 1
22.	77 8	75 2	35 9	34 11	28 8	28 6	47 8	44 3	42 11	41 4	49 1	47 5
29.	77 3	75 5	36 4	35 3	28 4	28 5	48 8	45 3	45 4	41 7	49 5	47 11
Oct. 6.	76 6	75 11	37 0	35 8	28 7	28 7	50 10	46 6	46 2	42 8	48 10	48 4
13.	76 7	76 7	38 4	36 3	28 6	28 5	49 8	47 8	48 7	44 3	49 11	48 10
20.	76 10	76 11	38 10	36 11	27 9	28 5	50 5	48 9	48 8	45 10	49 10	49 2
27.	78 4	77 2	38 6	37 6	28 8	28 5	50 1	49 7	49 9	46 11	51 3	49 9
Nov. 3.	80 3	77 8	39 0	38 0	28 0	28 4	51 3	50 2	51 2	48 3	50 8	50 0
10.	80 7	78 2	39 6	38 6	28 4	28 4	50 2	50 9	51 4	49 3	51 11	50 5
17.	80 10	78 11	39 11	39 0	28 0	28 3	52 10	51 0	50 4	49 11	52 0	50 11
24.	83 1	79 10	40 11	39 5	28 1	28 2	52 9	51 4	52 8	50 7	51 10	51 8

FOREIGN MARKETS.—Per Imperial Quarter, free on board.

Date.	Markets.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1855.		s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Sept. ..	Danzig	79 0 - 90 0	26 6 - 32 6	18 6 - 25 0	38 6 - 48 0	38 6 - 45 0	38 0 - 43 6
Oct. ..	Danzig	82 6 - 92 0	28 6 - 36 0	20 0 - 26 6	42 0 - 58 6	40 0 - 48 6	39 6 - 45 0
Nov. ..	Danzig	80 0 - 85 0	27 6 - 35 6	21 6 - 27 0	45 0 - 56 6	42 0 - 50 0	40 6 - 47 3
Sept. ..	Hamburg	76 6 - 85 0	30 6 - 38 0	20 6 - 28 6	38 6 - 47 6	38 6 - 46 0	38 6 - 47 0
Oct. ..	Hamburg	80 6 - 90 0	32 6 - 39 6	18 9 - 26 9	40 6 - 50 0	42 6 - 50 0	37 6;- 45 0
Nov. ..	Hamburg	78 6 - 86 0	34 6 - 40 6	18 6 - 25 3	54 0 - 66 0	41 6 - 51 0	33 6 - 47 0
Sept. ..	Bremen	76 0 - 87 0	27 6 - 35 6	18 6 - 24 6	40 0 - 45 6	38 0 - 45 6	37 6 - 46 0
Oct. ..	Bremen	81 6 - 90 0	29 0 - 37 6	18 0 - 25 6	42 0 - 48 6	42 6 - 51 0	38 6 - 47 0
Nov. ..	Bremen	78 6 - 85 0	29 6 - 39 0	19 6 - 26 6	44 6 - 54 0	40 6 - 50 0	38 6 - 47 3
Sept. ..	Königsberg	81 6 - 90 0	33 6 - 40 6	19 6 - 27 0	42 6 - 58 6	39 6 - 46 0	37 6 - 47 0
Oct. ..	Königsberg	80 0 - 88 6	35 6 - 39 6	20 0 - 28 6	45 6 - 60 0	41 6 - 48 6	39 6 - 47 6
Nov. ..	Königsberg	78 0 - 85 6	32 6 - 38 6	18 6 - 26 0	46 6 - 63 0	42 6 - 50 6	40 6 - 48 6

Freights from the Baltic, from 4s. 3d. to 7s.; from the Mediterranean, 7s. 6d. to 14s. 6d.; and by steamer from Hamburg, 4s. 6d. to 7s. per imperial qr.

THE REVENUE.—From 30th Sept. 1854 to 30th Sept. 1855.

	Quarters ending Sept. 30. 1854.	Quarters ending Sept. 30. 1855.	Increase.	Decrease.	Years ending Sept. 30. 1854.	Years ending Sept. 30. 1855.	Increase.	Decrease.
	£	£	£	£	£	£	£	£
Customs	5,349,251	5,713,674	364,423	..	20,316,431	21,607,218	1,290,787	..
Excise	5,212,782	4,946,776	..	266,006	15,744,613	16,710,391	965,778	..
Stamps	1,707,509	1,604,165	..	103,344	6,984,076	7,084,548	100,472	..
Taxes	133,577	111,374	..	22,203	3,153,773	2,915,036	..	238,737
Post-Office ..	343,000	261,757	..	81,243	1,365,000	1,158,181	..	206,819
Miscellaneous	216,166	255,073	38,907	..	1,262,230	1,211,383	..	50,847
Property Tax	2,545,056	4,538,646	1,993,590	..	6,965,614	13,449,761	6,484,147	..
Total Income	15,507,341	17,431,465	2,396,920	472,796	55,791,737	64,136,518	8,841,184	496,403
	Deduct decrease....		472,796		Deduct de rease....		496,403	
	Increase on the qr...		1,924,124		Increase on the year		8,344,781	

PRICES OF BUTCHER-MEAT.—Per Stone of 14 Pounds.

Date.	London. Beef.	London. Mutton.	Liverpool. Beef.	Liverpool. Mutton.	Newcastle. Beef.	Newcastle. Mutton.	Edinburgh. Beef.	Edinburgh. Mutton.	Glasgow. Beef.	Glasgow. Mutton.
1855.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Sept. ..	6 6 - 8 6	6 9 - 9 0	7 0 - 8 6	7 3 - 8 6	6 6 - 8 6	6 6 - 8 6	6 3 - 8 6	6 3 - 8 3	6 6 - 8 6	6 6 - 8 6
Oct. ..	6 9 - 8 9	6 9 - 8 9	6 9 - 8 0	7 0 - 8 3	6 6 - 8 3	6 3 - 7 9	6 0 - 8 3	6 0 - 8 3	6 9 - 8 9	6 9 - 9 0
Nov. ..	6 9 - 9 3	6 9 - 9 3	6 0 - 7 9	6 3 - 8 0	7 3 - 8 3	7 0 - 8 6	6 3 - 8 9	6 3 - 8 6	7 3 - 8 9	7 3 - 9 3

PRICES OF ENGLISH AND SCOTCH WOOL.—Per Stone of 14 Pounds.

ENGLISH.	s. d. s. d.	SCOTCH.	s. d. s. d.
Merino,	14 6 to 23 6	Leicester Hogg,	16 0 to 19 6
.. in grease,	11 6 to 15 6	.. Ewe and Hogg,	13 6 to 17 0
South-Down,	17 6 to 18 9	Cheviot, white,	14 0 to 15 6
Half-Bred,	13 0 to 15 6	.. laid, washed,	10 3 to 12 3
Leicester Hogg,	14 3 to 17 6	.. .. unwashed,	8 3 to 9 8
.. Ewe and Hogg,	13 6 to 15 0	Moor, white,	7 6 to 8 0
Locks,	7 0 to 9 0	.. laid, washed,	5 6 to 6 0
Moor,	5 0 to 7 0	.. .. unwashed,	4 8 to 5 8

THE AGRICULTURAL STATISTICS OF 1855.

We have to congratulate the farmers of Scotland on the patriotic spirit which they have evinced, in voluntarily submitting a second time to the inspection of the public these returns, which contain the results of their skill, enterprise, and labours during the past year—results which, however important they may be to the consumer, could not have been procured with equal accuracy by any other means. We have to congratulate the Highland and Agricultural Society on the success which has attended their labours, in working out the trust which they undertook at the request of Government. We have to congratulate the country on the unreserved publication of these returns, as evidencing the existence of as intelligent and public-spirited a body of tenants as are to be found in any country—a healthy tone of feeling subsisting between landlord and tenant, and a confidence in the honour of their rulers.

We do not intend here to discuss the value and importance of statistics generally, or of agricultural statistics in particular. This has already been ably and sufficiently done in the pages of this Journal and elsewhere. And we presume that the importance of obtaining accurate statistics on every subject, political and scientific, will now be universally admitted.

Though perfectly satisfied with the returns of the last two years, and with the machinery made use of to obtain the information contained in them, we hope that ere long the inquiry not only will include fuller agricultural details, but will be extended to other branches of trade. We should like to see several additional columns introduced, through time, into the agricultural schedule—as, for instance, the different breeds and cross-breeds both of cattle and sheep kept on the farm; also the different varieties of each cereal and root crop cultivated, &c. If, for example, we had been in possession of such full statistics for a sufficiently long period, how interesting it would have been to trace the progress of the Cheviot sheep from their native hills, gradually displacing the blackfaced breed, till they grazed on the majority of our mountain pastures; and then to mark the reaction which is taking place in some districts, where the blackfaced have again begun to assert their supremacy: or how instructive to determine the favourite varieties of wheat or other cereals in particular districts—that preference being clearly traceable to some peculiar adaptation of the one to the other.

But still we think that the changes introduced into the schedules this season, though reducing the columns in number, were judicious; for if the farmers are to make the returns, they should be asked

to return nothing more than what they are accustomed to work with. There are very many farmers who have no plans of their farms, and who will be unable to tell the number of acres in buildings, fences, waste, &c., or even permanent pasture, but who, from two or three years' experience, will come pretty near the extent of their lands under rotation; for they know that it required so many bolls to sow this or that field, so many days to plough the next, and so many tons of manure to be applied to another.

The estimates were made last year between the 15th and 30th of November. We are strongly of opinion that this is early enough in the season for all practical purposes, and to insure accuracy; and we decidedly think that there should not be an intermediate estimate. It has been strongly urged by some that an estimate should be made before harvest. For whose interest is this to be done? For that of the consumers? It will be found that, whenever the estimates are published, speculators, knowing the uncertainty of such premature estimates, and the great risks attending a Scotch harvest, will raise or depress the markets according to circumstances; and, as in all such cases, the consumers will be sufferers. We do not require to argue this question, for we have abundant evidence of what will take place from what happens every year immediately before harvest, when there are too many found ready to speculate on the probable produce of the new crop; and matters will be made no better by the publication of the uncertain estimates of the statistics. But we are told that it will be for the interest of the farmer to have an estimate before harvest. If speculators are to make a handle of such estimates, as we have already shown they will do, there can be no doubt of the producers being sufferers as well as the consumers. It is said by those who advocate an estimate before harvest, that it might be done as easily as the valuation of a crop for an incoming tenant. Leaving out of view, at present, the facility or difficulty with which such an estimate would be made for the statistics, we are sure that there are not many farmers who, being left to the tender mercies of the best qualified and most conscientious of their friends, as arbiters in the valuation of a standing crop, and having observed the great disparity in the yield of the crop as certified by the bushel on the barn floor, and as indicated by the arbiters' estimate, would place much reliance on such estimates.

We think it a delusion altogether to suppose that farmers are to be aided in selling their grain by any statistical returns. It may be regarded as an axiom in agricultural economics, that a farmer should always sell his grain as he threshes it out. He must thresh for straw, and he has very seldom any proper accommodation for storing grain when threshed; and it is now well established that, by the end of a nineteen years' lease, the farmer who acts on the

above axiom will be better off than he who has always been holding on for higher prices. Indeed, we may go a little farther, and say that he who threshes most off the stook, provided his straw is properly disposed of, either on or off the farm, will, in nine cases out of ten, draw most money per acre.

We object, then, to an estimate of the crop being taken before harvest: first, because of its uncertainty; second, because of its being as likely to contradict the succeeding estimate as not, and thus shaking the confidence of the community in the accuracy and value of the statistics. For it cannot be denied that the state of the weather at the critical period of harvest, and the risk of shaking from high winds at the same time, must materially influence the estimate taken after harvest, while they can have no effect upon that made of the standing crop. A third objection we have to an estimate before harvest is its impracticability, if we are to obtain reliable information from it. How is it to be done? Is it to be done simultaneously over the whole country, within ten days or a fortnight, in the late at the same time as in the early districts? Or is the estimate to be made in each parish when the crop is at a particular stage of maturity? Very different estimates will be made of a crop at different stages of its growth; and therefore, if the former plan is adopted, we can expect nothing but a most inaccurate estimate. And then if the latter method is adopted, which will no doubt insure greater accuracy, in most of the districts presided over by one enumerator, there will be a difference of a month or six weeks in estimating the crop between the early and the late parishes; and thus the inquiry will be comparatively useless to one part of the farming community, for a considerable portion of the crop will have been cut down and sold before the estimate can have been made public. We do not say that, in cases of great emergency, as in the prospect of a very deficient crop, it may not be advisable to use the statistical machinery for obtaining information regarding the state of the standing crop; for even an approximation to the truth, calculating on *a most favourable harvest*, which shows a deficient crop (however much it may differ from the second estimate), will tend to encourage importation at an early period, and thus prevent famine prices. But such a case we would regard as quite exceptional; and we would, for our own part, prefer one estimate, made as soon after harvest as possible.

We were glad to hear the resolution which was agreed to at the last general meeting of the Highland and Agricultural Society; viz., that the "Society expressed its willingness to continue the co-operation and assistance, as it has hitherto afforded to the systematic collection of the agricultural statistics of Scotland, so long as this does not interfere with the original and special objects of the Society." And we quite agree with Mr Finnie, who stated at

that meeting that, no part of the Society's affairs being neglected in consequence of the statistical inquiry, it was "the most legitimate way in which the Society could employ its time." Owing to considerable misapprehension being abroad as to the connection of the Society with the collection of the statistics, we think it proper to dwell longer on this part of our subject than we otherwise would have done.

Feeling a deep interest in the proceedings of the Society, none would have regretted more than we if its connection with statistics had impaired its efficiency as a national Agricultural Society, or led it to depart from its "original and special objects." To satisfy ourselves on this point, we subjected its proceedings, before and since it became connected with statistics, to a rigid review, the results of which we now present with pleasure to our readers. We are prepared to show that the Society has been more engaged during the last five years in initiating and successfully carrying through measures of importance to agriculture, and has had a larger addition to its members, than during any other period of its existence of equal duration. Nor has that test of the country's confidence in its proceedings, viz., the increase of its membership, been at all diminished since the commencement of the statistical inquiry.

We will now enumerate some of the numerous measures which have engaged the attention of the Society since it became connected with the collection of statistics. The subject of statistics was brought before the Directors in 1852. Since then, 1st, The Ordnance Survey, a question in which the country is deeply interested, has occupied the time of the Society, not only in deliberations at home, but in deputations to London. 2d, The Industrial Museum has been established, the merit of originating which belongs to the Society; and while we are not slow to award praise to those other public bodies which aided in carrying through this most important institution, it cannot be denied by them that it was immediately established through the powerful influence used by a deputation of the Society on Government. 3d, Winter Shows were commenced, and only given up from the want of support from the public, and the great loss they brought on the Society; but still it has expressed its willingness to continue them, if sufficient funds be raised for the purpose. 4th, In 1848 it was resolved that the General Shows should be only triennial, when there was not even the prospect of the Society having anything to do with statistics; last year it had four shows on hand for the succeeding four years, the correspondence connected with all of which, and the preliminaries of some of them, have been carried through. 5th, Its attention has not been in the least withdrawn from local shows; on the contrary, a new feature has been introduced into them, viz., the Competition of Reaping Machines, which takes place at the very time

when the duties attendant on the statistics are most pressing. 6th. The Directors, in their desire to improve the *Transactions*, had secured the valuable services of the late and much lamented Professor Barlow as editor on veterinary subjects, whose premature death took place before he entered on his duties. 7th, Arrangements have been made with Messrs Lawson for a new collection for the Museum, which will cost the Society £400. Now, all these important questions have engaged the attention of the Society, in addition to its ordinary business, during the time it has been connected with statistics. And we challenge any one to prove that, at any former three years of its existence, the Society ever showed more vigour and vitality, ever possessed more influence, or transacted more business, independent of statistics, than during the last three.

Whatever the Society has done, it still contemplates doing more. Its past labours have been successful, its present energies are not relaxed; its prospective measures, as important as any that it has carried through, will require the care, ability, and activity which it has hitherto shown. Among these we may mention the establishment of the Agricultural Institute, a subject which Professor Balfour, one of the directors, publicly announced lately, was again to be taken up by the Society. It will be remembered that in 1849 the Society applied for a supplementary charter to Government, to enable them to grant diplomas to those who wished them, provided they passed an examination on a course of study in scientific and practical agriculture prescribed by the Society. We are not aware that any new classes, or lectureships, or model farms were to be established. Owing to official hauteur and opposition the application was unsuccessful. There may be differences of opinion as to the value of such an institute; but it cannot be denied that the directors, and a numerous body of members, thought and still think, that its establishment would conduce to the elevation of agricultural education; and hence they have determined to renew their attempt to obtain their charter.

Nor do the *Transactions*,* the organ, as it were, of the Society, show any falling off. On the contrary, besides the excellent character of the papers in them being generally fully maintained, they are much enhanced in value by the publication of the results of the statistical inquiry in them. But even supposing that the efficiency of the *Transactions* were impaired since the Society became connected with statistics, we would by no means be inclined to blame that connection for their inefficiency. For who propose, write, and judge the essays in the *Transactions*? Why,

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* We take this opportunity of stating that the *Journal* is in no way connected with the Society, nor is the latter at all responsible for any article which appears in it.

principally the farmers of Scotland. The most intelligent of the farmers within an easy access of Edinburgh are requested every year to revise the premium list, and suggest any subjects they think proper as essays for competition. Any suggestions offered, as regards old or new subjects on the premium list, are submitted to a meeting of the same gentlemen, and their decision is seldom interfered with by the Directors. When the essays are given in for competition, they are distributed amongst the same body, and other scientific and professional gentlemen versed in the subjects of the essays, to be judged; and their award is final. It will thus be seen that if there are any shortcomings in the *Transactions*, they cannot certainly be attributed to the time of those in the Society, principally engaged with the collection of the statistics, being too much taken up with that duty.

So far as we recollect, we do not think that there was a single dissentient voice to the Society's taking up the question of the collection of statistics at first. On the contrary, every member thought it was a legitimate part of its duty which it was called upon to discharge, and the public generally approved of it as conferring a great benefit on the country. Now, if the Society had time enough the first year to set the matter in movement, to organise the machinery, to collect the lists, involving a correspondence of thousands of letters; if the Secretary had time to travel from Caithness to Galloway, with his well-known tact, ability, and energy, solving doubts, answering objections, explaining the system, converting stanch opponents into firm friends—in short, transacting the business of two ordinary men—we do not think that there will be found a member, who has rightly considered the question, who will not agree with us, that the Society can find time now to carry on the collection, when the business has dwindled down to mere routine and desk-work, with a staff quite independent of that connected with the ordinary business of the Society. We know not if, in satisfying our own mind as to the expediency of the Society being connected with the collection of statistics, and as to that connection "interfering with the original and special objects of the Society," we have also satisfied others who may have had doubts as to the policy of such a connection. If there were none to be satisfied on this point, we will still not regret having published the foregoing remarks, as they will tend to show in a broader light the many important and beneficial measures which have been originated and successfully carried through by the Society, and the really useful manner in which the time of all the officials connected with it is spent.

Anxious as the public have been to stamp with their approbation the successful accomplishment of the work of collecting statistics, pleasing as it has been to Government to express its thanks to those engaged in the work, eager as the press throughout the king-

dom has been to award praise to the Highland Society and the farmers of Scotland, we still think that there are but few who appreciate the full value and importance of the statistical tables just published. Most people, both agricultural and others, seem to look upon them principally or merely as an inventory of the stock and produce of the farmers—in short, of the agricultural wealth of the kingdom, and, by showing the gross produce every year, as a good safeguard against the evils which often arise from the uncertainty of the amount of available food for the people. Though they were of no other use than what we have mentioned, their value would be incalculable; but this is a very limited appreciation of the importance of the statistical tables. We are to regard them, in addition to what is stated above, as a valuable book from which we may read the yearly agricultural and social position or progress of the nation. The whole tenor of our succeeding remarks will bear us out in what we have stated; but we will at present explain our meaning more fully in one or two sentences.

An increase in the quantity of land under cultivation, an increased produce per acre, an increased breadth of some crops, such as wheat and the green crops, an increase in the number of animals kept per acre, will all indicate an improvement in agriculture. Again, it is universally acknowledged that the rise of a people in the social scale is shown by the improved quality of the food consumed by them; so, by a reference to the tables (where the produce forms their staple article of food), we will be enabled to tell the social progress of the people by the gradual increase in the cultivation of the finer kinds of plants, and the corresponding decrease in the cultivation of the coarser, *cæteris paribus*.

Well-merited encomiums have been passed on Mr Hall Maxwell for the important part he has had in collecting the statistics; in these we most cordially join. But we think that full justice has scarcely been done him for the admirable manner in which he has presented to the public the information which he obtained from the farmers. The tables are distinguished by a beautiful simplicity, combined with accuracy, clearness, and ease of reference. And as the geologist, in turning over the rocky leaves, and then reading the history of the progress of creation, pictures to his mind scenes which occurred thousands of years ago, so we may imagine the inhabitants of distant future ages turning over these statistical tables, and obtaining a clear succinct view of the state of agriculture in years that had been long forgot. They teach even us of the present day more than we expect. When we dip a little beneath the surface, and begin to examine the tables minutely, we see at first everything dim, misty, in confusion; but, as in the image cast by the Camera Obscura, when the proper focus is obtained, all becomes clear, the mist is dissipated, double lines disappear, confu-

sion becomes order, and we observe a clear well-defined image. Let us then subject the tables to such an examination.

Table I.—Acreage under Tillage.

In this table we find that there are 43,467 occupants returned, the particulars of the occupation of all of whom are detailed, with one single exception, whose schedule has been twice miscarried. The returns include those rented at and above £20 in the counties of Argyll, Caithness, Inverness, Orkney and Zetland, Ross and Cromarty, Sutherland, and the Island of Arran, and those rented at and above £10 in the remaining counties. It is certainly most gratifying that there may be said to be not a single exception out of such a large number.

Now we glean the following facts from this table. The average extent of land held by the 43,467 occupants is 81 acres, those in Haddington holding the largest—viz. 220 acres; and those in Argyllshire the smallest—viz. about 50 acres. As those occupants who hold two or more farms are simply returned as one, the average extent of the farms will be less than 81 acres. Of the distribution of crops upwards of two-fifths of the land in tillage are in grass, scarcely two-fifths in white crop, and about one-fifth in green crop. From a careful inspection of this table, it will be observed that three circumstances materially influence the distribution of the crops in the different counties—viz. climate, soil, and markets. For instance, we find that owing to the moist climate of the western counties there is a much larger proportion in grass and less in potatoes than in those on the east side of the island, and, as might be expected, less wheat proportionally grown on the west than on the east coast, Haddington producing the largest proportion, and Argyll the least. Of barley, the largest proportion is grown in Forfar and Fife, the smallest in Ayr and Renfrew. We do not think that we can attribute the great difference in the cultivation of barley in the two former and two latter counties so much to soil as to climate, the farmers of the latter having found the straw of this cereal too soft and too liable to be laid for their moist climate, while the rich dry soils in the straths of Forfar, eminently adapted for the growth of barley, with the moderately dry climate; have proved most profitable in raising that crop. More than likely the extensive distilleries in Fife, by opening up a market for barley, have aided most materially in extending its cultivation. We are not surprised at Aberdeen producing the largest proportion of oats. In the largest proportion of turnips grown, Berwick and Roxburgh stand first, and Renfrew last; while in the largest proportion of potatoes, Fife, Renfrew, Perth, are first, and Berwick and Roxburgh are last. The potato, being generally cultivated as food for man, we will naturally expect to

have more extensively grown near the centres of population; hence Renfrew, from the manufactures, trade, and commerce which are carried on in its principal towns requiring a large population, produces the largest proportion of this esculent. Partly for the same reason, Fife and Forfar stand high in the list of potato-growing counties. Two other important elements not yet alluded to also influence the cultivation of the potato—viz., the means of transport to the markets, and the disease. Perth and Fife have long supplied the London and other English markets with potatoes. The vessels frequenting their harbours, being principally engaged in the coasting trade, after discharging their import cargo, carry back to the English ports potatoes at a low freight. Lime and coals, for instance, are brought from Newcastle to Perth, and potatoes are shipped back. It was thus probably, that, a ready market being obtained, the cultivation of the potato increased in these counties to such an extent as to place them in the first rank of potato producers. The comparative exemption of Haddington from the potato disease, and the opening up of the county by the railway, have tended very much to increase the cultivation of the potato in this county, which is not far behind the counties we have mentioned above in the proportional extent under this crop.

The turnip, on the other hand, is raised more particularly as food for animals. Berwick and Roxburgh, at a distance from any large consuming population, and possessing improved breeds of cattle and sheep, which require superior food, and being obliged to convert their straw into manure, excel the other counties in the quantity of turnips grown, while they are about the lowest in the amount of potatoes produced. It may be asked why Berwick, being as favourably situated in point of water-carriage as Fife and Perth, and as favourable as East-Lothian in railway communication, should have fallen so far short in the cultivation of the potato? One or two reasons may be given for this. A great part of the arable land of Berwickshire—that in the Merse—is not so well adapted for potatoes; probably, also, the clause which we know existed in many of the leases, and which is perhaps general in that county, prohibiting the sale of potatoes off the farm, restricted the growth of that plant; and it is not unlikely that, even though the farmers may have the liberty of selling potatoes, their proximity to the Newcastle and Morpeth markets for their cattle and sheep induced them to prefer the cultivation of the turnip to that of the potato for the rearing and feeding of their stock.

It is also interesting to observe how, from this table, we can read the state of the markets of the previous year. From the encouraging prices of 1854 for most articles of farm produce, we have less bare fallow in 1855 than in 1854. From the high price of wheat, its cultivation has been increased by about 23,000 acres;

and that of barley, which was almost unsaleable, has decreased about 21,000 acres. The price of oats being good, the extent in them has remained almost the same. The high price of beef, and the greater quantity of turnips used by cowfeeders and others as substitutes for more expensive food, have increased the breadth of that root in cultivation by about 15,000 acres. So also potatoes; while the quantity in flax has been reduced to about one-half. Such is the influence that the price of any crop has upon its cultivation. We turn now to

TABLE II.—STOCK.

We find here much to interest us—much for speculation. We learn that somewhat more than 58 acres of the land under tillage is the average allowance for a pair of horses throughout Scotland. In examining, further, as to the acreage for each pair, we ought to bear three things in mind—the soil, the rotation, the system; which last we will explain by taking the Lothians as an example. We find that in East-Lothian the number of acres for the pair of horses is 62, in Mid-Lothian 60, and in West-Lothian 66. Now, by a glance at Tables I. and II., we see that a much larger proportion of West-Lothian is in grass than in the other two, and more in Mid-Lothian than in East. But in Mid-Lothian there are more extra horses required on the farm to carry the milk and butter from the western part of the county to Edinburgh. This is also the case in a small part of West-Lothian; while in East-Lothian feeding of cattle and sheep is the only system practised.

We may lay it down almost as a rule, that the smaller the holdings, the less the acreage allowed for the pair of horses, as in the Highland counties of Argyll, Inverness, Perth, Sutherland, Aberdeen, where 42, 36, 48, 37, 59, are the acreage per pair respectively. It is true that in these counties there is very often kept on the small farms a brood mare as one of the pair, which of course reduces somewhat the effective strength, unless her place, when she is off work, is supplied by a young horse, which is generally the case, so that we need not consider this as militating much against the rule. From this we may learn the unprofitableness of working small holdings. If there are exceptions to the rule, these can be explained by much more of the land being in grass, which is especially the case in the counties of Ayr, Renfrew, Lanark, where fully more than one-half is in grass. In the other counties, where there is a less proportion in grass, Roxburgh gives 72 acres and Berwick 70 acres to the pair of horses. There are about 3¾ more horses for agricultural purposes above three years old than under three years. If we suppose the numbers returned under the column for young horses to consist of foals, one-year-old and two-year-old horses, we will have about 12,000 agricultural brood mares,

making an allowance for those that may have missed foal. And by comparing the first and second columns of the table, we find that the principal rearing counties are Argyll, Bute, Kirkcudbright. As we are uncertain what the "all other horses" include, we offer no remarks on them.

The columns on "cows," "other cattle," and "calves," bring out distinctly those counties in which the centres of population are found, or where the produce of the cow is consumed by man as milk or cheese; those devoted to breeding, those to rearing, and those to feeding. Thus we find that the largest proportional number of cows is in Ayr, Lanark, and Renfrew, without a corresponding number of calves; showing that the first, from the quantity of cheese made, while it requires a large number of cows, cannot afford to give milk to calves, and that the two latter avail themselves of the manufacturing, trading, and mining population in them for the consumption of their milk. Then, as regards breeding, Aberdeen, Banff, Inverness, Kincardine, and some others at a distance from ready markets, bring up as many calves as they have cows; while Berwick, which, with Haddington, returns the smallest number of cows, has actually more calves than cows. It is not so easy to distinguish those counties in which rearing is practised from those in which feeding is done, as all the rest of the cattle are classed under one head. It is worthy of remark, that while there is little difference between the numbers of cows and calves returned for 1854 and 1855, there is a considerable increase in the number of other cattle in 1855, viz. nearly 31,000. Does not this account in some measure for the reaction which took place last autumn in the lean markets, when lean cattle became almost unsaleable?

As no distinction is made in the columns for sheep between those on sheep-farms proper and those kept on arable farms, and as there is no return of acreage of the hill pastures, we can make no fair comparison as to the numbers kept in the different counties. The division in 1855 also into classes is different from that of 1854, so that we are precluded from making any comparison between the two years. There is one remark we will make, however, on the disparity between the "sheep of all ages for breeding" and the "lambs." As might be expected, there are fewer lambs than "sheep of all ages for breeding" in all the counties but three, viz. Berwick, Linlithgow, and Fife. The difference in Fife is trifling, viz. 70 more lambs; but in the other two counties it is marked, the numbers being for Berwick 91,300 sheep, and 94,377 lambs; and for Linlithgow 2861 sheep and 4029 lambs. To account for this, we must suppose either that there was a great importation of lambs into these counties, or that a considerable number of the ewes had been sold off before the schedules were returned; or we may make another supposition, viz. that the stock

of sheep kept in Berwickshire being principally bred and half-bred, the crop of lambs, always larger than from any other kind of stock, will account for the excess of lambs; while in Linlithgow, if we suppose that half-bred cast ewes only are bought in, from which one crop of lambs is taken, and they are then sold off, the disparity will be accounted for.

Of swine there is a considerable decrease in 1855 from that of 1854, arising, no doubt, from an increased consumption of pork instead of beef, and fewer being kept on account of the high price of the articles used by them as food. The scarcity has been felt very much since the lifting of the potatoes, so many of which being diseased, the demand for pigs to consume them became much greater than the supply. Let us now study

Table III.—Estimate of Gross Produce per County.

This is generally considered the most important table by the public, if we judge from the constant reference which is made to it by writers on the subject of statistics. It is, in fact, the gross result of the harvest; and as such is keenly inspected by speculators, producers, and consumers. The first remark we will make is, that the results, though differing somewhat from those of last year, corroborate them in the great difference which exists between these returns and the estimates of the gross produce made by writers on statistics. Thus we find M'Culloch stating the acreage and produce of the grains to be as follows:—

	Commercial Dictionary.		Geographical Dictionary.		Statistics for 1855.	
	Acres.	Produce. qrs.	Acres.	Produce. qrs.	Acres.	Produce. qrs.
Wheat,	350,000	1,137,500	220,000	660,000	191,300	632,638
Barley,	450,000	1,800,000	280,000	980,000	186,082	761,621
Oats,	1,200,000	6,000,000	1,275,000	5,737,500	933,662	3,760,169

Now, in making any comparison between crops 1854 and 1855, we should bear in mind that an important difference exists between the returns of the two years; for while light grain was generally excluded from the returns of 1854, it is all included in those of 1855. This we consider a judicious alteration, for as the horses are all returned, and the light grain is generally consumed by them, we can see no reason for not taking it into account in making up the estimates. Another reason why we think it advisable to include the light grain, is to have uniformity in the returns. Some

farms produce more light grain than others, and some farmers, in cleaning the grain, throw out more light grain than others. Now, if the good grain only was to be taken into account, it is plain that the acreable produce would be returned much lower in some cases than in others, though the value of the gross produce might be quite the same in all the cases. The principle we believe generally followed by the enumerators and members of committee in reducing the light to good grain, was to reckon 1½ bolls of light grain as equal to 1 boll of good. We do not think that we will be making too great a deduction from crop 1855, which contained a large proportion of light grain, if we allow 2 bushels of light for every 10 quarters of good wheat, 1 quarter of light for every 12 quarters of good barley, and 1 quarter of light for every 7 quarters of good oats. The returns for the two years, therefore, will stand thus:—

	Crop 1855.	Crop 1854.
Wheat, ...	616,823 quarters.	606,085 quarters.
Barley, ...	698,153 „	955,666 „
Oats, ...	3,223,002 „	4,261,631 „
Bere, ...	63,818 „	80,677 „
Beans, ...	147,958 „	135,158 „
	4,749,754 quarters.	6,039,217 quarters.

Thus it is seen that of the five descriptions of crops mentioned above, there were 1,289,463 quarters in 1854 more than in 1855. There are about 50,000 tons of turnips in 1855 more than in 1854. There are, according to the table, upwards of 200,000 tons of potatoes in 1855 more than in 1854. But this does not indicate the true difference, as the small potatoes are included in the estimates of last year, which was not done in those of the previous year. The diseased are not included in the estimates. Now, making a similar deduction for small potatoes as we did for light grain, say 3 cwt. for every 1½ ton, we will get 658,853 tons as the comparative gross produce of last year's crop, or about 129,000 tons of difference between the two years. We find that Fife gives the largest gross produce of wheat and barley, Aberdeen the largest gross produce of oats and turnips, and Fife and Perth the largest amount of potatoes. We leave this table at present, till we have examined the succeeding ones, and will proceed to

Tables IV. and V.—Estimates of Average Acreable Produce per County and per District.

As table IV. may be said to include table V., we may confine our attention to the former. We will first draw attention to the average acreable produce of Scotland, which is not directly stated in the table.

	1855.									1854.		
	According to Table.			With Light Grain deducted.								
	bu.	pks.		bu.	pks.					bu.	pks.	
Wheat, . .	27	1½	per acre.	26	3	per acre.				29	3	per acre.
Barley, . .	33	0¾	"	30	1¾	"				36	1	"
Oats, . .	32	1⅕	"	27	3	"				36	1¾	"
Bere, . .	31	2½	"							33	0	"
Beans, . .	25	3¾	"							29	0⅔	"
	tons.	cwts.		tons.	cwts.					tons.	cwts.	
Turnips, . .	14	10	"							15	5⅓	"
Potatoes, .	5	0	"	4	10	"				3	12	"

Of the averages per county, Argyll and Sutherland, Caithness and Selkirk give the largest acreable produce for wheat. This is not to be wondered at, as these counties, having but a few acres in wheat, and being nearly beyond the proper limit for wheat cultivation, select the best of their ground, and manure it more heavily, to secure a crop. The lowest acreable produce of wheat is in the counties of Dumfries and Wigtown. Haddington has the highest acreable produce of barley, Argyll next, and Perth the lowest. Of oats, Haddington has the highest, Selkirk and Ayr the next, and Inverness and Arran the lowest acreable produce. Of bere, Edinburgh has the highest, Haddington and Peebles the next, and Dumbarton the lowest acreable produce. Of beans and pease, Kincardine has the highest, Banff the next, and Sutherland the lowest. In turnips, Dumbarton and Clackmannan are highest, and Nairn lowest; and in potatoes, Orkney is highest, Selkirk next, and Ross and Cromarty lowest.

Last year a most useful inquiry was added to those of the previous year; viz., that into the quality of the grain crops. It was not completed in time to be published with the rest, but it has now been laid before the Board of Trade, whose sanction it has received. We cannot make any comparison between the weights per bushel of 1854 and 1855, as that is not distinctly brought out in the report; but we learn from it that the quality of crop 1855 is considerably below that of 1854, and somewhat below an average. We give the average weights per bushel for Scotland, as indicated by this return for crop 1855:—

Wheat, ...	60½	lb. per bushel.
Barley, ...	52¼	"
Oats, ...	39¼	"
Bere, ...	49	"
Beans, ...	62¼	"

Elgin returns the highest weight per bushel for wheat, Haddington and Argyll next, and Kinross and Renfrew lowest. Elgin is also highest for barley, Inverness, Ross, and Cromarty next, and

Caithness lowest. Haddington is highest for oats, Elgin next, and Ayr lowest. Banff is highest in bere, Kincardine next, and Lanark lowest. Wigtown is highest in beans, Haddington next, and Argyll lowest.

In estimating the value of a crop, its quality is a most important element, and hence the utility of this supplementary table. It is generally admitted that the weight per bushel of crop 1855 is 2 lb. lighter than that of 1854; by reducing, therefore, the gross produce of the two years to weight, we will have a more correct view of the values of the two crops, thus:—

	1855. Tons.		1854. Tons.
Wheat,	143,248	...	135,242
Barley,	130,280	...	185,160
Oats,	451,795	...	627,729
Bere,	12,125	...	14,694
Beans,	32,893	...	31,013
	770,341	...	993,838
Potatoes,	658,853	...	529,915
Turnips,	6,461,988	...	6,411,419
	7,891,182	...	7,935,172

These are the weights of the gross produce of crops 1854 and 1855, excluding the light grain and small potatoes in both cases. But we would be labouring under a great mistake if we supposed that all the grain returned in the tables is brought to market and sold to consumers. There is a certain fixed quantity in every crop required for the purposes of the farm, which must be deducted before any can be sold. This quantity includes grain and potatoes for servants, for horses, and for seed. As we merely wish to illustrate at present our proposition, we will simplify it as much as possible, by not taking into account what is used for domestic purposes in the farmers' houses, by supposing that there are eight men for every six pairs of agricultural horses above three years old, who are paid with grain and potatoes as part of their wages, and also by supposing that all the light grain and small potatoes, and none of the good marketable produce, is consumed at home by the horses. This, we know, is less than is really the case, but it is sufficient for our present purpose. In calculating the fixed quantity required for seed, we will take the acreage of 1855 as being a nearer approximation to crop 1856 than 1854 under present circumstances. We are aware that writers on statistics generally make an allowance for the seed; but in their calculations they class agricultural labourers with the rest of the population, forgetting that the available produce for consumption by the other classes is only the surplus after all the requirements of the farm have been satisfied; so that we may have in famine years the agricultural labourer well fed, while the other classes may be starving.

We will take the counties of Berwick, Edinburgh, and Haddington as the basis of the whole of Scotland, in the different quantities of grain which are paid to servants as part of their wages. We find, then, that the average quantity of oats given in these three counties is $7\frac{1}{4}$ quarters, of barley $1\frac{3}{4}$, and of beans $1\frac{1}{4}$, and the quantity of potatoes allowed about 21 cwt. We may mention that the quantity of potatoes, and the manner of giving them, vary much even in the same county, some farmers giving a certain quantity, while others give the land and manure, and plant the potatoes, as is generally done in Berwickshire and Haddington. The number of men or families paid in kind will be 80,000. The sums to be deducted, then, will be as follow:—

	For Servants.	For Seed.	Total.
	qrs.	qrs.	qrs.
Wheat,	—	59,781	59,781
Barley,	140,000	69,700	209,700
Oats,	580,000	583,539	1,163,539
Bere,	—	6,473	6,473
Beans,	100,000	13,978	113,978
	820,000	733,471	1,553,471
Potatoes,	84,000 tons.	73,484 tons.	157,484 tons.

These, then, are fixed quantities, which must be deducted from the gross produce before we can ascertain the amount available for food; and it follows, that the more deficient the crop, the less will be the proportional amount that will be sold off the farm. We find that the whole available surplus from crop 1855 will be 3,196,283 qrs. of wheat, barley, oats, bere, beans—a sum very different from that stated by Mr M'Culloch, viz., 7,572,917 qrs., under deduction of seed. The quantity of available potatoes, supposing them to have been well kept in the pit, from last year's crop would be 501,369 tons.

Our space will not permit us to add some more remarks, which the examination of these Tables has suggested to us. We hope, however, that the hints which we have thrown out will induce others to prosecute an examination of them; for we can assure them that they will find much food for speculation, much that will interest them, both as regards the state of agriculture and the social position of the people. We have already stated, that it is our desire to see several additional columns made through time to the schedules; in short, a more complete system of agricultural statistics, including returns of the quantities and varieties of light manures, and of cattle-food used on the farm. We do not think that any one will consider the extension of the queries to be answered as too inquisitorial. Every farmer must now be satisfied that the trust which has been committed to those connected with the collection of the statistics has been held inviolable—that no unfair use has been made of the returns.

We think that we have sufficiently shown above that the Highland Society can undertake the charge of the collection of agricultural statistics, without "interfering with its special and original objects." Indeed, we consider it a far more legitimate way of spending the time not occupied by these special objects, in collecting and perfecting these statistics, than in agitating for a more extensive system of statistics on every branch of trade. For who, we ask, are better qualified to produce a perfect system of agricultural statistics than the staff now engaged in the collection of the statistics? We are as anxious as any one for an extensive system of statistics; and when that is obtained, then, we would say, should the connection of the Society with the collection of statistics cease. And we are certain of this fact, that neither the Directors nor the Secretary will consider it any hardship to be relieved of duties which they have undertaken solely from a sense of the public good.

But further, we do not think it possible for Government, or any other body, to work out the statistics with the agency that has been established by the Society. Withdraw the sanction of the Society's or its Secretary's name, and unless a new element be introduced, the whole present machinery will fall to pieces, and Government will then probably have to make the collection compulsory. Nor do we object to a compulsory measure; for we are one of those who think that if such a measure be introduced for England, there should also be a compulsory clause for Scotland, to be enforced only when found necessary, as an acknowledgment to the farmers of this country of their public-spiritedness. It may be thought advisable, if a measure be introduced for England, to sever the connection between the Highland Society and statistics, so as to have uniformity in the collection. To this no one at all appreciating the value of correct and uniform statistics would object.

The time will come when the importance of agricultural statistical tables will be more studied both by agriculturists and the community at large than they are at present. Even now, a farmer may avail himself of them, in some degree, in certain circumstances connected with his profession. Suppose, for instance, that he is offering for a farm in a district comparatively unknown to him, by consulting these tables he will be able to learn what crops, what system, a lengthened experience has decided it is best to cultivate and follow there; what is the acreable produce, and what the quality of the grain grown. This is no slight information for a stranger going to a new place. And we may fancy, years after this, a man of ordinary education and ability reading from these tables, with the aid of an Ordnance survey map, a physical atlas, and census tables, the history of the agriculture and of the social progress of the people of Scotland.

We cannot bring these remarks to a close without expressing

our sense of the obligations under which the country has been laid by Mr Hall Maxwell for the able and satisfactory manner in which he has discharged this branch of the Highland Society's duties. Manifesting his usual attention, zeal, and ability in the management of the ordinary business of the Society, he has shown himself possessed of still more varied qualifications, which have been called forth in the carrying through of the statistical inquiry. And it is satisfactory to know that, while the people are truly grateful to him for the labours he has undergone, his valuable services have also been acknowledged by Royalty in the honorary distinction lately conferred upon him.

CULTURE OF CAROLINA RICE.

By R. Russell, Kilwhiss.

Having several introductions to the rice and cotton planters in the neighbourhood of Savannah, I left Charleston for that town on the afternoon of the 11th of January 1855, in one of the mail steamers, which usually make the passage in ten hours. Before the sun set I had a view of some of the "sea islands," upon which a portion of the famous long staple cotton is raised: their surface is only elevated a few feet above tide; and in general the soil is light and sandy. Where the land is uncleared, pines are the predominating trees of the forest. The weather was close and foggy next morning as we sailed up the Savannah, but as we reached the wharf the sun broke through, and the air felt mild and genial. Many were considering it too warm for the season, for the thermometer was 68° in the shade in the afternoon.

Savannah is about eighteen miles from the sea, and situated on the south or right bank of the river of the same name. It is built on the sandy soil of the Pine Barrens, and is about forty feet above the level of the river. Its situation is dry and airy, but, in consequence of the immense extent of rice-ground to the northward and westward, it is very insalubrious in summer. Malignant fevers then frequently decimate the white population, more especially those who are not acclimated.

The exports are cotton, rice, lumber, and a small quantity of sugar. Though the exports of cotton are nearly as large as those of Charleston, and a great amount of commerce is carried on, there is much less appearance of a wealthy class of residents. The population by the last census was only 23,000 souls, of whom upwards of 9000 were slaves. So large a number of the population being slaves, whose condition is nearly stationary, and much inferior to

that of the free labourers who have all their own earnings at their disposal, the town has not the vigorous aspect of the towns in the Northern States. There has been no want of taste in laying it out: the streets are wide, and there are numerous squares, planted with the live or evergreen oak and the pride-of-India tree; but the thoroughfares are mostly unpaved, and vehicles of all kinds move about, almost unheard, over the soft sand. The houses of the wealthy classes are situated on the south side, at a considerable distance from the river. Camellias in flower were quite common in the gardens; there were also a few small orange-trees, which were far from being vigorous; and the finest street was in close proximity to the sombre pine-forest. There appeared so little traffic towards the sterile interior, that the town had the appearance of being a stranger in the wilderness.

There is so much uniformity in the geological structure of Georgia and the Carolinas, that a description of the physical aspects of the country on both sides of the Savannah will suffice for that of all the other rivers in these States. At the mouth of the Savannah the coast is low and sandy. It belongs to the post-pliocene formations, and forms a part of that immense tract of sandy soil, well known under the name of the "Pine Barrens," which fringes the North American continent from Southern Virginia to the banks of the Mississippi. Its breadth is about one hundred miles in South Carolina, and it is almost wholly covered with pines. Along the coast it is only a few feet above the level of the sea, but it gradually rises towards the Blue Ridge of mountains. A belt of tertiary formation succeeds, consisting of sands and clays, upon which the upland or short-stapled cotton is raised. This, in its turn, is succeeded by soils derived from the primary rocks of the mountain range. Considerable quantities of cotton are also raised on these primary soils, which, unlike those derived from the same rocks in any part of the British Islands, are in many instances of considerable depth, and derived from the decomposition of gneiss and mica-schist *in situ*. Indeed the tertiary and the primary soils have often so much resemblance in lithological characters, that they must be examined with care to distinguish them. Where the land of the primary rocks becomes elevated, the culture of cotton gives place to that of Indian corn and wheat.

The Savannah is navigable as far up as Augusta, which is 250 miles by the river from the sea. The tertiary soils extend as far as Augusta, where the primary formation begins. This formation forms the termination to the navigation of the most of the other large rivers which drain the Atlantic slope, because their beds then become hard and rocky, whereas throughout the tertiary formations they have excavated deep channels out of the softer materials of which the country is composed, and flow to the sea with a fall of

a few inches to a mile. At the mouth of the Savannah and all the other rivers of the South-eastern States, the country beyond the tide-swamps is low and sandy; but as one sails into the interior the banks or "bluffs," covered with pines, become higher.

At Savannah, the river, at low water, is confined within a channel of 300 yards in breadth, and it is about 30 feet in depth. At high water, before the country was settled, the rich alluvial land, which now forms rice-grounds, was covered twice a-day by the tides, and was thus a vast swamp. The trees on the rich swamp-lands throughout the Southern States are of great size, but they are almost all deciduous, consisting principally of tupelo gum, ash, and cypress; the undergrowth, cane and various vines. The swamps which now form the rice-grounds were reclaimed by erecting embankments along the sides of the river, and preventing the overflow of the tides.

The above sketch will give a more correct idea of the country 4 miles above Savannah than any written description. The sandy bluffs on both sides are about 40 feet above the water, and the rice-grounds extend for more than 3 miles from the channel of the river towards the northern bluff. It happens that there are no rice-grounds on the south side for several miles above the town.

In Georgia and the Carolinas there are a good many marshy grounds in the pine region, that are caused by beds of clay sending the water to the surface in springs. They are composed of black vegetable matter too deficient in earthy materials to be possessed of fertility of any great permanence when cultivated. It was on such soils, however, that the first settlers raised rice; but being easily exhausted, recourse had constantly to be made to new lands. Though a considerable quantity of rice is here and there raised over the upper country on such soils, and even on the dry cotton lands, for domestic use, none of it is reckoned sufficiently good in quality for exportation. The discovery that the tide-water swamps were particularly well adapted for the culture of rice is comparatively recent. At first the barren sandy soils were much more valued than they are now, because indigo was raised upon them, and was one of the great staples of the country. This article can now be brought to the European market at a much cheaper rate from our possessions in India, and its culture has therefore been abandoned in the United States. A great revolution has

thus taken place in the relative values of the swamp grounds and the dry pine-lands. The value of the latter is at present merely nominal, while good rice-grounds are worth far more than any other land in the country. The common price of rice-grounds in the neighbourhood of Savannah is £30 per acre, and some on the Cooper River were sold at £40. These prices are more than double those of the best sugar-lands on the Mississippi.

It is on the *tide-water swamps* of the Savannah, and the numerous other rivers in Georgia and the Carolinas, that the fine rice known in Europe as the Carolina rice is cultivated. The production of rice for exportation is in a great measure confined to these swamps; and it is further limited to the *fresh*-water-tide swamps,—for where the tides are salt, or even brackish, they are unsuitable for irrigation. Rice is cultivated about four miles below Savannah, and twelve miles above it.

When one stands on the top of the steep bluff at Savannah, a fine view is got of the vast swamp which stretches to the westward and northward. In some parts of the rice-grounds magnificent trees are seen, now bare and destitute of leaves, but covered with grey moss hanging like drapery from every branch. With the exception of some live oaks, and also a few cabbage palm-trees, which remind one that he is approaching the tropics, the general mass of vegetation, notwithstanding the warmth of the weather, looked as dead as it does here in December.

I visited some plantations both below and above the town. They are mostly large on this river, though they vary from 200 to upwards of 1000 acres in rice crop. From the nature of the works which are required to reclaim the tide-swamps, and render them fit for cultivation, large capitals are invested. Rice can thus only be cultivated on the large-farm system, and where labour can be commanded. In some districts in which rice-culture was early introduced, the plantations have been much diminished in size by the division of property among families. On the Black River in South Carolina, some of the plantations are as small as 60 acres; but this is found to be about the minimum extent to which profitable culture can be carried. When such small estates come into the market, they are almost invariably bought by adjoining proprietors, and the tendency to large properties being again formed is thus seen.

I spent a day riding over the rice-plantations about 4 miles above Savannah, in company with several large proprietors. Keeping out of view the miserably tame scenery on the banks of the Savannah, the river itself bears a considerable resemblance to the Tay at Newburgh in Fifeshire. Reeds were growing in the rich alluvial soil flooded by the tides, and the embankments raised to protect the rice-grounds were in every respect similar to the *dykes* which protect the wheat-fields of Parkhill, or of Mugdrum

Inch. After crossing the river in a boat, and getting mounted on a pony on the bank, the low and level lands, stretching as far as the eye could reach to the west and east, and more than three miles to the sandy high grounds, gave me at once an idea of the vast extent of land which had been rescued from the tides, and rendered so productive.

The soil of the rice-grounds, for more than a mile from the river, is very fertile, consisting of a strong clay, rich in vegetable matter. Towards the high grounds it is more peaty, in consequence of the earthy matter brought down by the river having been mostly deposited near its channel by the swamp-growth acting as a sort of filter. From the want of the earthy matter, this is a very poor soil—just as much so as our own peat-mosses are before they are improved by clay or sand.

Main canals, having sluices on their mouths, are dug from the river to the interior about 20 feet in width; and as they sometimes extend across the whole breadth of the swamp, they are more than 3 miles in length. The rice-plantations are subdivided into fields of about 20 acres each. The fields have embankments raised around them, with sluices communicating with the main canal, so as they may be laid dry or under water separately, according as it may be required. Numbers of open ditches are also dug over the grounds, for the purpose of allowing the water to be more easily put on or drawn off.

Considerable diversity prevails in the mode of cultivating the rice crop. Some planters plough all the grounds every year. Those who follow this system give a light furrow in the beginning of January, and afterwards make shallow furrows or drills 15 inches apart to receive the seed, which is sown broadcast at the rate of from 2 to 3 bushels per acre. A small quantity of water is then admitted for a day or two, until the grain sprouts.

The plough used on these rather strong soils is exceedingly light, and drawn by a mule. I have seen a negro woman carrying one on her shoulder from one field to another. On a plantation of 500 acres under rice, I found that 22 mules performed the whole ploughing, besides that of cultivating 70 to 80 acres of Indian corn on the light sandy soils of the pine country. No one can say that there is any waste of animal power in this case. Rice-culture involves a large amount of manual labour, for about 100 negroes, men and women, are required to tend and reap the crop on this extent of land, and take the grain to market. This number of field hands was only got out of 250 negroes, young and old. The common calculation is, that the working hands are about one-half of the total number of negroes on the plantation.

The most approved and general mode of cultivating the rice-fields, when free from weeds, is to sow the seed without ploughing. The stubble of the previous crop is burned over in spring, which

is easily effected from the large quantity that is left at harvest. A negro then goes into the fields, and makes a rut with a hoe between the rice rows of the former crop. This serves as a receptacle for the seed. Sometimes this operation is done by a small drill-plough. The seed is either covered with a rake, or the water is admitted at once, and covers it by washing down the soil.

In all cases, the water is admitted to the fields as soon as the seed is sown, and when the young shoot appears above ground the water is drawn off. In the course of a week the crop usually receives another watering, which lasts from 10 to 30 days, according to the progress which vegetation makes. This watering is chiefly useful for killing the land-weeds that make their appearance as soon as the ground becomes dry. But, on the other hand, when the field is under water, aquatic weeds in their turn grow up rapidly, and, to check their growth, the field is once more laid dry, and the crop is then twice hand-hoed. By the 1st of July the rice is well advanced, and water is again admitted and allowed to remain on the fields until the crop is ripe. This usually takes place from the 1st to the 10th September. The water is drawn off the day previous to the commencing of reaping. The rice is cut by the sickle, and the stubble is left from 1 foot to 1½ feet in length, according to the rankness of the crop. A day after being cut it is bound up into sheaves and carried by the negroes to the bank of the main canal, whence it is carried in flat-bottomed boats to the threshing-machine. The rough rice is then sent to Savannah in boats.

Such is a very general outline of the method which is followed in the culture of rice: the particulars are varied, according to many circumstances which arise. So far as I had an opportunity of judging, I thought that the planters displayed much skill in the management of their estates. The most of the rice-planters are highly educated men, fully alive to every improvement, and give close attention to the management of their properties during winter, spring, and the early part of the summer, when the climate is particularly healthy.

The average produce of rough rice on the Savannah swamps is estimated at from 45 to 55 bushels per acre. Though the fields have been long under cropping the produce is still large, but there is no doubt that it is smaller than when the land was first cleared; still from 70 to 80 bushels are sometimes got on old cultivated fields. Crops of rice are usually taken in succession as long as the land is clean; but when it becomes foul through weeds, or the "volunteer rice," it is laid under dry cultivation for a year. This is attended with great benefit; for although no manure is applied, and two crops—one of oats and another of potatoes—are taken, yet the land is so much renovated that the succeeding crop of rice is often increased by a half, and sometimes even doubled. The

oats are sown in the beginning of January, and the surface of the ground is merely scratched with a hoe to cover them. The warmth and moisture of April and May commonly send up a very thick and tall crop, which almost smothers the grass and the "volunteer rice," and it is ready to be harvested by the end of May. As soon as the land is cleared of this crop, potato-stems are planted in 5-feet rows, and during the growth of the potatoes the intervals are thoroughly cultivated by the hoe and the plough. The manner in which the potato-crop is managed I have never heard of being adopted elsewhere. The tubers are planted in March or April on dry pine-barren soils that have been well manured. An immense mass of stems grows up in this climate under such treatment. The stems are cut off and transplanted in the rice-fields, and one acre of them serves to plant twenty. And what is singular, the crop from which the stems are cut, is by this process rendered more abundant. This arises apparently from the crop being forced to grow throughout the warm season, and its perennial tendencies being so far developed. The quality of the potatoes which are raised in the Southern States is very inferior—the tubers are soft and waxy, particularly so on the rice-grounds. The finest potatoes which I saw in America were on the table of a rich planter with whom I dined one day. On my putting to him the question, whether they were the produce of his rice-grounds, about which he had been talking highly in the morning, "Oh, no!" he replied; "these, I suppose, are from Liverpool."

The "volunteer rice," which is interesting in a physiological point of view, causes a great deal of trouble to the planters. The rice-seeds that are shed when the crop is cut, and that lie over the winter, produce an inferior quality of grain, for they then appear to revert to their natural state. Though the husk of the volunteer rice is of the same light-yellow colour as that of the finest quality, the kernel is red, and a few grains of this kind in a sample detract much from its market value. There are several varieties of volunteer rice, and they are usually the most vigorous plants in the field; and as some of them ripen before the main crop, they fall out and increase with great rapidity.

The rice plant adapts itself in a most wonderful manner to the most opposite conditions of soil in respect to moisture. There is no cultivated plant that bears any resemblance to it. The same variety that grows on the upland cotton-soils and on the dry pine-barrens grows in the tide-swamps where the land is laid under water for weeks at a time; and even in the lower part of the delta of the Mississippi, where the fields are under water from the time of sowing to the time of reaping.

Rice straw, on the dry upland soils, ripens when the grain ripens, as is the case with that of our cereals; and the stubble dies

at once. Many must have observed, however, that the ears of oats and barley that have grown on damp peaty soils ripen long before the straw, and the stubble often retains a certain amount of vitality and freshness for some time after the crop is cut. But in the irrigated tide-swamps the vitality of the rice plant is prolonged to a most wonderful extent by the system to which it is subjected. When the rice is ready for harvesting, and all the grains in the ear are quite hard with the exception of a few of the lower pickles, the stem and leaves remain quite green. The rice grows from 3½ to 5 feet in height, and, as already said, considerably more than a foot of stubble is left. No sooner is the crop cut than the stubble sends out shoots and leaves from its *top-joints,* and in some instances it has produced as many as 30 bushels of rice per acre as a second crop from the same sowing. This is a curious physiological fact, and one that does not seem to be generally known, for on going to New Orleans, Dr Barton called my attention to a communication by a French writer who had discovered a method in Egypt whereby two crops of rice might be got from one sowing. The plan was not made known, but I told him that I thought it could be no other than that which was well known to the Carolina planters. The autumn frosts, however, generally cut down the second growth before the grain has time to ripen. But every season, after harvest, a considerable growth of stems and leaves takes place, and the rice-fields are then represented as assuming all the appearance of a second summer. These leaves and stems are killed by the first night's frost, and afford a large quantity of withered vegetable matter in spring, which readily permits of the whole fields being fired during a dry period, and to be thus cleared and fitted for being once more scratched with the hoe, and sown with rice.

It is readily seen that large capitals are necessary in the culture of rice on the tidal swamps. A great expenditure of labour is constantly required to maintain the banks in good order, to clear out the drains and canals, as well as to keep the sluices and valves in repair. It would be far from satisfactory to give any detailed estimate of the expenses and profits of rice culture. The fact, however, of the rice-grounds being higher in value than any land devoted to any other crop, is quite sufficient to attest the profitableness of rice culture. Nor is this so much to be wondered at when it is considered that the land which is capable of raising rice with advantage is comparatively limited, and has been almost all occupied for a considerable time. This is the reason why the exports of rice from the Southern States have not been increasing for many years. The demand for rice in America far exceeds its supply as a common article of food, for it is but a very small portion of land upon which it can be profitably raised. The slaves on the rice and cotton plantations are supplied with Indian-corn instead

of rice. The latter is used more as an article of luxury, for it is far higher priced than Indian corn. In the tropical parts of the British possessions in India, where the cultivated land is all irrigated, rice is the cheapest article of food, as it is by far the most productive grain-crop in low latitudes.

From the conversation that I had with the planters in the neighbourhood of Savannah, I became fully persuaded that Indian corn is much less prolific in the Southern States than in the Northern. This was amply confirmed afterwards by the planters in the delta of the Mississippi. The produce of Indian corn, on the rich alluvial lands of Georgia or of Louisiana, is less than the half of what it is on soils of the same fertility in Northern Kentucky. The moister atmosphere and higher temperature of the South develop a great growth of stems, while the produce of grain is comparatively small. This is perhaps the chief cause of the planters in the cotton districts importing such a large quantity of corn from the Northern States. Considerable quantities of rice are raised throughout the cotton-region in dry culture; and though the produce varies much in different years, it is probably greater than that of Indian corn in the average of seasons. One of the "crackers," or small farmers, who cultivate the poorest pine-barren lands, assured me that he did not raise more than ten bushels per acre of Indian corn, though the land was manured: with the same treatment, twenty bushels of rice would be reaped.

The objection to the culture of rice on the dry upland soils arises from the much greater amount of manual labour which is required to keep the crop free from weeds. The lengthened period of hot weather over which its growth is extended, and particularly the circumstance of this crop, like our cereals, either being sown broadcast or in narrow drills which do not admit of horse-hoeing, tend to give great encouragement to weeds, so that its culture demands too much hand-labour to be generally profitable. Rice also requires much more labour to prepare it for food; and hence, although 40 bushels of rough rice are often got on the cotton-lands of the uplands that rely for a supply of moisture on the summer rains, the more easily tended Indian corn is the great staple, even in the Southern States, where it is much less productive than in the North. The very successful culture of rice in the tidal swamps has much to do with the economy in the amount of labour required to raise the crop, through the extraordinary manner in which the rice-plant can withstand the extremes of being laid dry or under water at intervals—a process which materially serves to destroy both the land and water weeds.

The rice-grounds are comparatively healthy to white men in winter, but they are the very reverse in summer and autumn, when the crops are growing and ripening. It has been often remarked, that the swamps, in their original state, along the

Southern rivers of the United States, were by no means so deleterious to the whites as they are now, when brought under cultivation. This seems to apply, to a certain extent, to all the rich alluvial soils in the river bottoms, but is particularly applicable to the rice-grounds that are irrigated by the tides. Indeed, the undrained swamps remain comparatively healthy so long as they are covered with the natural vegetation. The mere stirring of the soil, and the exposing of it to the atmospheric influences of a hot climate, invariably give rise to malaria. For this reason, the Campagna in Italy became much more unhealthy, as Dr Arnold states in his *Roman History*, after its drainage. It is said to be attended with extreme danger to a white man to remain, during the hot season, for one night on the rice-grounds of Carolina. Captain Smith very properly contends, in his excellent work on *Italian Irrigation* (vol. ii., p. 359), that there is nothing deleterious in the mere culture of rice, but in the mode in which the irrigation is managed. This opinion, I may here remark, is confirmed by the fact that the rice-grounds at the mouth of the Mississippi, on which the water is not allowed to stagnate, are more healthy to the white inhabitants than either the sugar or cotton grounds of the lower Mississippi, that are under dry culture. But the practice adopted on the tide-swamps of Carolina, of laying the fields dry at intervals during summer and autumn, seems to give rise to miasmata of the most deadly character to the white inhabitants, but from which the coloured are exempt. The planters, with their families, invariably leave the rice-grounds during the hot season, and remain in a more healthy part of the country until the crops are harvested.

Though the negroes are not liable to those diseases which are so fatal to the white inhabitants in summer, yet they do not increase in the rice districts. In fact, I was informed that it requires good management on the part of the planters to keep up their numbers, so as to do away with the necessity of going into the market to buy. This circumstance alone is a great drawback in the profits of rice-culture, for on the cotton plantations, with ordinary care, there is a constant increase in numbers. The damp ground and the nature of the labour render the negroes very liable to pulmonary diseases. The children, also, are particularly subject to measles and hooping-cough, which often prove fatal. One planter informed me that he now sends all the children born on the rice-plantations to his cotton estates in the interior. Out of sixty children he had only lost four, and experience convinced him that the loss would have been at least four times greater had they remained on the rice-grounds.

So far as I could learn, I have every reason to believe that the negroes on the rice-plantations have a liberal supply of food and clothing. About half a pound of bacon a-day is the usual allowance for an able-bodied negro, with Indian-corn meal and molasses.

They almost all have the privilege of keeping pigs and poultry of their own, which they sell, and are thus enabled to buy tobacco, tea, and other groceries. A planter one day pointed out an old negro to me, who had not done any work for ten years, but who had got his rations regularly with the others, and a few days before this he had sold two pigs for 30 dollars.

The cost of providing the negroes, old and young, with food and clothing, is from 30 to 40 dollars a-head. The value of slave property has been gradually rising for several years; but a slight reaction had taken place about the time of my visit, owing to the pressure in the money market. At the present time, the negroes in the rice plantations are worth upwards of *one hundred pounds* (500 dollars) all round; some sales had been made as high as *one hundred and fifty* (750 dollars). Good field-hands bring considerably above 1000 dollars. Negroes were not worth much more than fifty pounds (250 dollars) twenty-five years ago.

The discipline maintained on all the plantations is almost as strict as that of our military system; and so long as slavery exists, a certain amount of firmness seems quite necessary for maintaining due regularity and authority. As we rode over the rice-grounds above Savannah, we came up to a gang of more than twenty negro men clearing out one of the main canals. They were up to the middle in water, and were throwing out the soft mud upon the bank along which we rode. Here for the first time I saw the black "driver," with a long whip tied round his shoulders, superintending his brethren, who worked as methodically as machines. I believe, if they had got no orders to desist from their occupation till we passed, that we should have got the benefit of the clearings. A loud shout from the "driver" brought the whole to a stand. Then we were subjected to their vacant and complacent stare. In other parts of the ground the women were working with the spade and mattock in repairing the banks. They were all well clothed and provided against the changeableness of the climate.

Before going to the south, I had been led to suppose that the planters were all very sensitive on the subject of slavery, and that I should avoid the topic in conversation. But I soon found that they had no such feeling in the matter: with some of the Cuban planters it was different, for I came to understand that the physical condition of their slaves, and the treatment which they received, were as matters of etiquette not to be alluded to. On the contrary, a large proprietor of rice-grounds on the Savannah told me "to go and inquire into the moral and physical condition of their negroes, with as much freedom as I would among the agricultural labourers in Lothian or Berwickshire, and to go home by Jamaica, and make a comparison between the emancipated negroes and their own slaves."

Savannah being situated on 32° 05′ parallel of latitude, some specimens of the animal kingdom, as well as of the vegetable, remind us that the tropics are not so far distant. The alligator is very often to be seen in summer in the river, but it buries itself in the mud during the cold season. Several species of turtles are to be found; and a small terrapin, so much esteemed for making soup, disappeared into the canal of the rice-grounds one day as I rode along the banks. The large turkey-buzzards which belong to the vulture order were wheeling over the fields in quest of prey in all directions. At the quarters of the negroes a large flock of these birds were set up, which had congregated around some carcass. Being seldom molested, they are very tame, and sat quite close to us; they even frequent the streets of Charleston during the day, and pick up all kinds of carrion. The American rook, very like our own, but having a much more sonorous croak, was making himself heard in the leafless swamp-forest. The sky being without a cloud, and scarcely a breath of air stirring, the weather felt rather too warm for riding.

A great disaster befell the rice crop of 1854 on several of the tide-swamps of Georgia and Carolina. One of the most violent hurricanes that has occurred this century happened on the 8th September 1854, when some of the crop was cut down, and the most of it nearly ripe. High tide occurring at the same moment that the easterly wind was blowing with its greatest fury, an extraordinarily high tide was the consequence. The salt water of the sea was driven up the river far beyond its usual limit, and, rising above the level of the rice-ground embankments, deluged the fields with salt water. More than three-fourths of the rice on the Savannah swamps was thus destroyed. As I rode over the grounds, I saw evidence of the great loss of property which had taken place. In some of the corners of the fields the rice in the straw lay over the ground from 3 to 4 feet in depth. Much of the grain did not appear to be greatly injured; but as the medical men had given their opinion that it was neither fit for food to man nor beast, it was piled into heaps to be burned. Such accidents seldom occur, and no efforts are made to guard against them, as it is deemed almost impracticable to do so.

This hurricane was one of those curious meteorological phenomena which are found to be connected with certain atmospheric disturbances, extending over the North American continent and the Caribbean Sea, and which have been the subject of much speculation among meteorologists. From various circumstances I was much interested in this particular storm, and I here may make a few remarks upon the subject.

Mr W. C. Redfield of New York and Sir W. Reid have both arrived at the conclusion that all the storms of the continent of the

United States are rotatory in their character, and have a progressive motion from *south-west* to *north-east*, after reaching the 30th parallel of latitude. Almost all our British men of science have adopted the same views.

I was rather glad to find, however, that the American men of science are more than divided on this question. Professor Espy maintains that all the winter storms travel from a point or two north of west to a point or two *south of east*, and that, instead of the atmospheric disturbance being confined within a circular area, its length is at least three times greater than its breadth. Professors Hare and Loomis so far concur with Espy on this point, and it appears to me, from so complete and satisfactory evidence, there is little room for two opinions on the matter. Each of these gentlemen, however, holds different views as to the manner in which the storm is propagated from west to east. Professor Espy is also inclined to draw a distinction between the winter and the summer storms.

I had attempted to apply a modification of Dalton's views to some of the most important phenomena of the American winter storms. On reaching Charleston, my kind friend Professor Gibbes put into my hands a printed memoir containing his investigations of this hurricane which deluged the rice-grounds. He and Mr W. C. Redfield had arrived at the conclusion that this was a rotatory storm, and that the course of its axis was nearly along the coast from Florida to Newfoundland. But having already examined the weather of this period in the Northern States and Canada, I was led to suspect that these autumnal West Indian hurricanes are also, like the winter storms, consequent to certain changes which take place in the north-western territories of the United States. I had an opportunity of drawing the attention of the American men of science to the grounds for my suspicions on this point, in one of my lectures which I gave before the Smithsonian Institution at Washington. For certain reasons, the autumnal storms are more difficult to examine than the winter. But, with all deference to Professor Espy, for whose profound knowledge of the physics of meteorology I entertain the greatest respect, I am still more inclined than ever to believe that the *modus operandi* of the two is nearly similar. This view has been greatly confirmed since I have had an opportunity of examining the valuable observations which have been collected by Mr Redfield on the celebrated Cuba hurricane of 4th to 7th October 1844. I was much indebted to this gentleman for presenting me with the interesting results of his investigation on this widely-extended atmospheric disturbance, but at the same time I do not think they support his particular views. It now appears to me, after further investigation and reflection, that the chief difference betwixt the two consists in the propagation of certain of the attendant phenomena from

west to *east* (somewhat to the *south of east*), being from three to four times more rapid in the winter than in the autumn storms.

At the request of Professor Espy, I made an effort, which was not successful, to obtain a committee of the British Association to examine into this matter. The present state of the science of meteorology loudly calls for it. The greater number of the members of the Association seem to have already made up their minds upon the theory of storms, and apparently regard farther inquiry as superfluous. I hope that the Scottish Meteorological Society may soon be in the position to do something in this investigation; were it to do no more than to determine which of the half-dozen or more theories so totally different from each other, but which all go under the name of "Rotatory," is the true one, it would do a vast deal. As a matter of curiosity, I may mention a circumstance to show that opinion is much more divided in America on this subject than at home. Like all other travellers over the United States, I have now and then met with individuals who are somewhat national, and display a considerable amount of feeling towards England on political or social grounds. The sons of Erin, especially, often seem to bear us no great goodwill. Such displays, however, are exceedingly rare among the educated classes of Americans. In the south, it is true, no doubt, that the cords of love have been weakened because of our sympathy for "Uncle Tom." But I must confess that I was rather amused one day at a little display of national feeling on grounds which were neither political, social, nor religious. I had hardly got over the formalities of an introduction to a distinguished chemist and mathematician, before I was told, "You Englishmen are altogether asleep on the subject of meteorology. Not only do you assume that the rotatory theory is true, but you assume that no observations are correct unless they are consistent with that theory."

But to return from this digression into which I have been drawn, attention may now be directed to the effect of rice-culture on the relative numbers of the free and slave population. The rice-grounds on the north of the Savannah are in the district or county of Beaufort in South Carolina. This district is about 60 miles in length, and has an area of 1540 square miles. Scarcely any other produce is raised for export than cotton and rice. The cotton is of the long-staple variety, and is cultivated on the light soils of the sea islands, and along the coast, extending for 20 or 30 miles into the interior. The tide-swamps of the Savannah, the Coosawhatchie, and the Combahee afford a large area fitted for the culture of rice. As already stated, the nature of the works required for the culture of this crop, tend to render the average size of the plantations large, and the disproportion of the numbers of the free and slave population very considerable. From there being no large towns in this district, the disproportion is greater than in

any other on the Atlantic seaboard. According to the census of 1850, the population was 38,805, of whom 6526 were free, and 32,279 slaves.

The agricultural statistics collected by the census commissioners, enable us to obtain an approximate estimate of the produce of the labour of this number of slaves. It is right to observe that a considerable number are employed in the pitch and lumber trade in those parts of the pine-forests where easy access is got to the shipping ports. At the same time, the production is 47,000,000 lb. of rice, which, at an average value of 5s. per bushel, amounts to nearly £210,000, and 12,672 bales of cotton at £25 per bale of 400 lb., amounts to £317,800. These two sums give a produce of £527,800, or nearly £16 a-head for the slave population. Besides these staple articles of export, about half a million of bushels of Indian corn and as many potatoes are raised for home consumption. The sum of £16 a-head appears small in comparison with some of the returns furnished by the cotton districts in the bottom-lands of the Mississippi. But in the Beaufort district the numbers of slaves that are non-agricultural must be considerable, without reckoning those who are employed as domestic servants.

Several large mills are built in the neighbourhood of Savannah and Charleston for preparing the rice for market. This process consists in drying the rough rice, then shelling it by grinding-stones, as our millers do with oats before manufacturing them into meal. The small portions of the husks of the rice that remain on the pickles after the grinding, are taken off by pounding in large mortars with huge pestals driven by steam. The finishing process consists in polishing the rice by brushes made of hair. The rice which grows in the tide-swamps is of much better quality than what grows in dry cultivation: The pickles of the irrigated rice are large and equal in size, and the husk is easily separated from the kernel; whereas the upland rice, being smaller and more unequal, the sample is not only inferior, but there is a great deal more waste and labour in its preparation for market.

During the whole time that I remained in the neighbourhood of Savannah, the weather was of the most delightful character. The days were soft and sunny, and the nights warm and exceedingly pleasant. The temperature at ten at night was sometimes as high as 64 degrees, with the sky perfectly clear. At the hotels some of the company were usually seated in the open air until late in the evening, and the crickets were heard without-doors. The thermometer was sometimes considerably above 70 degrees during the warmest part of the day, and the atmosphere being almost still, it felt too warm for walking. To me there appeared to be a most unnatural contrast between the heat of the weather and the general deadness of vegetation. The rough and coarse grasses, which are natives of this southern region, were quite withered,

and showed no signs of vegetation. The rice, cotton, and sugar fields were all as uninteresting as our own fields of stubble or fallow are in March. The trees in the tide-swamps being mostly deciduous, were exposed to such a heat as would have made all our deciduous trees put forth their leaves in a few days in mid January. The evergreen pine was abundant enough, but pines are green in Norway in winter. The few orange and evergreen shrubs in the gardens had rather an exotic appearance. This suspension of vegetation in the Southern States during winter, when there are often considerable periods of warm weather, arises from the frequent occurrence of frosts at night, when the north-west winds prevail, and the temperature is then often lowered to freezing along the coast of the Atlantic as well as that of the Gulf of Mexico. Indeed, I had personal experience some weeks afterwards of the severe cold to which these low latitudes are occasionally subject; for a little to the north of Mobile the thermometer fell 10 degrees below freezing at sunrise, and the mercury did not rise more than one degree in the shade above freezing at mid-day with a bright sun.

The mean temperature of winter at Savannah is about 53 degrees. This is nearly about the same as that of the month of May in London, and also of the winter at Cadiz, which is 4½ degrees of latitude further north than Savannah. But from the great extremes of which the temperature of the American climate is made up in winter, a very different class of plants forms the predominant vegetation from what prevails in the south of Spain, where frosts are comparatively rare. Vegetation is a much better guide to a knowledge of the peculiarities of climate than *mean* temperatures. The orange-trees are liable to be killed down by frosts over the whole territory of the United States, with the exception of the southern parts of the peninsula of Florida. But they are altogether exempt from such casualties in the south of Spain. The cotton plant furnishes a still more delicate test of the extreme climate of the low latitudes of the north-eastern American continent. In the south of Spain it is a perennial shrub, but throughout the most southern parts of the cotton zone of the United States its stem and branches are killed down every year by frosts, so that the fields require to be sown every spring.

The markets of Charleston and Savannah are pretty well supplied with vegetables in winter, but the variety was smaller than I expected. The vegetables are raised on poor sandy soils, which require to be highly manured; and during the winter and early spring a considerable trade is carried on in sending such as do grow to Baltimore, New York, and other northern cities. I saw only turnips, cabbages, celery, and radishes in the markets. I was told that no green pease were got until the beginning of March in the earliest seasons. A succession of crops is then got till June,

but none in July or August, but again in September and October. Early potatoes are not ready for table before the latter part of April or beginning of May—little sooner, in fact, than they are to be had at Land's End, in the south of England. Second crops are obtained in September and October, but the northern crop then comes into competition. The climate of the Southern States does not seem particularly well adapted for the growth of market vegetables at any season—at least I found some parties in New Orleans making great complaints of this nature.

The climate of the summer months is intensely hot and very moist in the rice-grounds. On an average, about 23 inches of rain fall, and the temperature obtains a mean of 80 degrees. Such conditions give great force to vegetation. The early autumn is also very hot, and drier than summer, and this seems to promote those miasmatic emanations which are so injurious to the white population. Yellow fever often visits Charleston and Savannah during this season, and new cases generally occur until the first frosts, which seem to have the power of entirely checking its ravages.

OUR MODERN TOWN-DRAINAGE SYSTEM: IS IT RIGHT OR WRONG?

The Question considered with reference to its connection with Agriculture.

The modern system for disposing of our town-drainage, and which we may here term the Government one, inasmuch as it is advocated by the Board of Health, a Government body, may be simply designated as that, the principle of which is, *the quicker* ALL *matter is conveyed from the neighbourhood of man's dwelling the better.* Poison the rivers, defile our streams—no matter, so that we get rid of our sullage; make our drains and sewers mere carriers or tributaries to convey the noisome matter to the river; and let this be?—no matter what. In considering this plan, there appears to be at the very beginning a moral point involved, not to dwell upon those of a pecuniary or social nature. There seems to be sound truth, we think, in Mr Page's * remark, "If we are bound to remove a nuisance from ourselves, we are morally bound to consider the consequence of transferring it to others." The evils resulting in this and other ways have

* The well-known engineer who was sent by Government to inquire into the "Croydon Pestilence," brought about by the defective construction and arrangement of the drains and sewers, carried out on the principles advocated by the Board of Health.

led men of high standing to advocate the adoption of a plan the very reverse of this—namely, that it is not necessary, in a sanitary point of view, and very impolitic in a pecuniary one, to remove the *valuable agricultural portion* of town sewage from the neighbourhood of man's dwellings; that, on the contrary, the principle should be adopted of retaining it for a stated period, until taken directly for the purposes of culture.

The points involved in the consideration of those two very diverse plans are of such importance to the practical agriculturist, that we deem a few pages devoted to them will not be considered irrelevant, and certainly they will not be altogether uninteresting. For the economisation of space we shall consider the subject in manner as follows: 1st, The principles which have led to the adoption of the modern system of pipe-drainage, and quick conveyance of sewage from man's dwellings; 2d, The causes which have led to a consideration of the value of the town-sewage, thus taken away, for the purposes of agriculture; 3d, The plans by which the sewage matter is proposed to be applied to the land under the present system of drainage. The consideration of these will lead to that of the opposite plan, and a detail of the methods by which it is proposed to carry it out. The points thus classified will not require to be treated much in detail, the principal purpose of our paper being to give the reader an idea as to how the matter stands, so as to direct attention to the important points involved.

1st. The system of modern town-drainage seems to have arisen thus—(the speculation is not our own, at least the words describing it are not; we owe them to an excellent and characteristical letter to the *Society of Arts Journal*, by the well-known writer, W. Bridges Adams.) "In the earliest river-settlements, the inhabitants of the dwellings found the stream so convenient a carrier, that they threw all their 'dirt' into it. As dwellings thickened and receded from the river, the inhabitants dug holes called 'cess' or collective pools, to save themselves a daily journey to the river. Water overflowed the cesspools, and it became essential to score the surface of the ground, to help it in its course to the river. Becoming an olfactory nuisance in time, these scores were covered over, and became sewers." These sewers increased in dimensions with the increase of inhabitants, and carelessness in construction, and a want of attention to principles, ultimately brought them into the condition of what has been designated "alembics sending forth the seeds of disease and death." With a view to mend the matter, but in reality only increasing the evil, "gully holes" were opened into those sewers, as if the point desiderated was to afford every facility to the noxious gases, generated in them, to spread abroad, and mix as directly as possible with the air, which filled alike the wretched abodes of the poor, and the gilded saloons

of the rich. Then came the disease; and to the search for the remedy. It very soon became evident that the decomposing matter, thus poisoning the air, was most assuredly the "wrong thing in the wrong place." The first impulse was to get rid of it. Where? No matter—get rid of it. How? Then the recollection of the old river-carrier flashed across men's minds; and water! water! was the cry. It is easy to understand how so mobile a vehicle as water would be at once taken as the best for conveying quickly away the sewage of our towns; and so it was: a most elaborate system of pipe-drainage was instituted and carried out wherever it *could* be adopted, by which the refuse of a house was conveyed to the sewers, and that of the sewers to the river, the removal being effected mainly by the aid of water. At length the system was fairly inaugurated, and apparently established as the correct one, when it came to be discovered that the mere getting rid of the sewage was not the only thing to be considered, but that the matter, thus so anxiously desired to be carried away, was in itself valuable, and worthy to be retained for some purposes, at all events. How this came about we now proceed to notice under the second point of our classification.

It is somewhat interesting to note how a truth which, applied to practice, is productive of great results, is sometimes acted upon intuitively by a nation or class of people—at least, so patent is it to every one, that it is difficult to go back to the time when a belief in it did not exist; while, on the other hand, we find other nations to whom the discovery of the truth or principle, and the value of its application, has been the work of a long term of years. The investigation of the cause of this widely different state of matters, although interesting, comes not within the scope of this paper, save only to furnish us with an illustration. Thus the grand process of "conversion," carried out in nature, by which the excretæ of animals become the food of plants, and these again become the food of animals, is universally known and acted upon in China and some of the states of Europe—so much so, that not only the excretæ of animals, but those of the human family, are hoarded up with jealous care and applied to the land. But when we look into the records of the history of agriculture, as practised among the Anglo-Saxon race in Great Britain and America, we find a widely different state of matters existing. With us, in our island home, we have long, by rule of thumb, acted somewhat upon a knowledge of the grand process of nature we have alluded to, but it has been to an exceedingly limited extent. Indeed, it may be said with truth, that until the researches of Liebig and Johnston were made known, the science of manuring was non-existent, and agriculture in this department, however entitled to be considered as an art, had no pretensions to be looked upon as a science. The value of *animal* excretæ for agricultural purposes was only dimly perceived; that

of *human* was totally unknown, or at least, if known, rarely acted upon; and even yet some of our farmers are halting between two opinions, as to whether they really are useful, and worth applying, or not. We have reached a certain point in our education in the grand science of agricultural chemistry, and now occupy the debatable land, where we seem to consider the policy of resting satisfied with what we have attained, or of pressing forward to still greater perfection. The American farmers have scarcely, as a body, got to the first stage of agricultural chemistry, but a few have a perception of the "grand process." Hence we find that many, totally ignorant of it, cast away, even at great trouble, valuable manure, and throw it into the river: what, with a knowledge of the very base of good agriculture, they would hoard up as valuable, they, through ignorance, get rid of as worthless.

As a nation, we in Great Britain act somewhat like the farmers of America. We have been throwing away, year after year, materials which possess highly fertilising powers—employing costly vehicles in the shape of mighty sewers, subterranean streets, and a complex ramification of pipes and drains to pass them into the river. In one sense we act even more foolishly than the "Cute Yankees" —not over "cute" in this respect at least. They are blessed with new virgin land, which yields for years the treasures of fertility which the vegetable accumulation, and other causes of ages, have given it; and, in consequence, require no manure to force a luxuriousness. We throw away, however, valuable manure upon our own shores, and wisely bring others, at greater cost, from those of other and distant lands, to enrich our exhausted soils.

It is somewhat singular that general attention was so long kept back from the consideration of what must have been an obvious truth—obvious wherever thought of—that if animal excretæ was so valuable as a manure, that of man was also likely to be equally so, and worthy of a trial, at all events. At length, by dint of the repeated efforts of our agricultural chemists, and others interested in the progress of agriculture, general attention was forcibly directed to the fact, that the "refuse of our towns and villages," so long looked upon as a nuisance which society was bound to get rid of, and put out of sight, was possessed of properties which, under certain circumstances, would make it a valuable commodity. But by the time an anxiety to avail themselves of this newly-discovered fertiliser was diffused amongst agriculturists, our modern system of town-drainage may be said to have been fairly inaugurated, and tried on a pretty extensive scale; thus introducing a new complication into the question as to how this town-refuse was to be taken to the country, where it was only available. For there seems no doubt of the fact, that if we, as a nation, had started in our course of civilisation and town-extension, with the knowledge of the "grand process" widely diffused and

acted upon, we would have had arrangements somewhat different from those we now possess, comparatively perfect as they may be held to be, by which the "fertiliser" could have been healthily dried up *till*, and cheaply taken away *when* wanted. This brings us to the consideration of our next point—the plans by which the sewage-matter is proposed to be applied to the land under the present system of town-drainage.

The plans proposed have been two, each of which has its able and persevering advocates. They differ widely in character. The one proposes to convey the liquid-manure to the land to which it is to be applied, by a series of pipes, through which it is to be forced by the pressure obtained by steam-pumps, or natural gravitation. The other proposes to collect the sewage-matter in tanks, and to deal with it in such a manner, chemically and mechanically, as to deprive it of the fertilising materials, which are proposed to be conveyed where required in the solid form. The one plan, therefore, proposes its application in the liquid, and the other in the solid form; hence has arisen a keen, and in some instances not an over-gently carried-on discussion as to the relative merits of the two forms. This, be it noted, is a point of discussion apart from the other question as to which is the least expensive way of treating the liquid-manure so as to obtain its fertilising properties. As in other points, so in the discussion of this, a vast mass of information, as interesting as it is valuable, has been elicited. The question, however, of the relative value of liquid and solid manure, *as such*, is not that now to be considered, although doubtless, if one plan be proved better than the other, a point in favour is obtained for the system which affords the manure in this the better form.

The body which has exerted great influence—we may say the greatest—in introducing or recommending the *liquid distribution*, is the Board of Health, and the gentlemen connected with it. This follows almost as a natural consequence of the system of drainage which they have been the great means of introducing, and advocating most perseveringly—namely, the tubular system of drains, and the employment of *water* in large quantities, as the moving vehicle for conveying quickly away the contents of the drains.

While, doubtless, it is true that the mobile vehicle of water is one admirably adapted to aid in the removal of the sedimentary matter usually contained in sewage water, and that the more water you can send down your drains and sewers, the less chance will there be of their becoming choked up with deposits; still, on the other hand, it is equally true that every addition to the moving or flowing force of the sewage matter, obtained by increasing the quantity of water, must, of necessity, decrease the value of the sewage as a fertiliser. Thus, while we perceive that if the object of our town-drainage system is merely to convey away the sewage as quickly as possible, the admission of water to act as the moving

power is essentially necessary, if efficient drainage is desiderated. It is also obvious, that if the object of our town-drainage system is to supply us with a fertiliser in addition to its other objects, the more water we add to our drains, the further do we depreciate the value of the fertiliser. Thus, then, we find that if we advocate the tubular system of drains with their water-carriage as the correct one, we are placed in a dilemma out of which it is difficult to move. If, to keep the sewage matter as strong as possible as a fertiliser, we do not use much water, then, by the stoppage of the drains, or at least the sluggish flow of the sewage through them, we do not come up to the *sanitary* requirements of the question; we make our drains, in fact, "elongated cesspools." On the other hand, if we sweep out quickly the contents of our drains by the aid of large bodies of water, we reduce the value of the sewage as a fertiliser, and do not come up to the *agricultural* requirements of the question. It is with the discussion of the latter we have to do.

In connection with the supply of manure to our agricultural districts, it may be taken as a maxim, that the more concentrated it is, the cheaper it will be to the farmer. On this point Professor Way remarks: "The carriage of a cheap manure was obviously the same as that of a dear manure. Guano, for which they were paying £10 a ton, they could take into the country at a cost of not more than 10 per cent of its value; but this same cost of carriage would amount to 100 per cent on the value of a manure costing £1 per ton, and the farmer could not afford that. The tendency was very properly now to increase the value in a given quantity of manure. If it was worth £30 per ton, so much the better, provided it contained the same value as could be supplied by £30 worth of other descriptions of manure." As all are agreed in the one point, that sewage water of towns, even when largely diluted with water, is a fertiliser of *some* value, the point narrows itself to an engineering one, whether it can be conveyed to the land at a cost which will render it pecuniarily valuable to the farmer. It is upon this the whole question hinges, and it is on this that opinions become most diverse. Mr Chadwick, who may be said to represent those who advocate the liquid distribution as embodying at once the sanitary and agricultural requirements of the question, states decidedly that the sewage of London—taking this as a type of other towns—can be supplied to the farmers in the neighbourhood at a cost that will pay. On the other hand, engineers—our most eminent ones, in point of fact—state distinctly that the estimates on which Mr Chadwick founds his doctrine are quite erroneous, and much below that for which they could be carried out. Still farther, in opposition to Mr Chadwick's views, attention is drawn to the fact which we have already noticed,—the comparative dearness of manure affecting the cost of

transmission. By Mr Chadwick's plan of water-carriage, the valuable portion of the sewage is deteriorated, and a per-centage of the cost of conveying the sewage to the land is taken up in conveying water alone, so that the farmer, while wishing manure, finds that he has to pay for water also. But against this objection Mr Chadwick places the fact, which he states his estimates bear him out in, that while 1 ton of solid manure costs, we will say, 15s. for transmission, 72 tons of liquid manure can be conveyed the same distance for the same money. Of course the relative values of the two must be taken into account, as it is quite possible that the 72 tons of liquid manure may be of less value than the 1 ton of solid. And here we come to the general average composition of town sewage. We may take it for granted, in coincidence with the opinion of first-rate authorities, and the results of general experience, that "the chief source of its (sewage) valuable constituents must be the excrements of the population." Taking all classes, ages, and sexes of the population together, Mr Lawes—the well-known agricultural experimentalist—found that 2 ounces of solid matter were daily ejected by each individual, and 3½-10ths of nitrogen were ejected in the same manner. Professor Way found it to be 2¼ ounces "as against Mr Lawes' 2 ounces of solid matter, and 36-100ths of an ounce of nitrogen." While noticing the striking coincidence of these results, Professor Way remarks, that "he thought, therefore, the question of the average composition of sewage water was set at rest, and that so far the subject was exhausted; for when two persons came nearly to the same point by different routes, he thought it might be considered that they had arrived at truthful results." Returning to our illustration of 72 tons of liquid manure, conveyed for the same money as 1 ton of solid manure, Mr Lawes—in the discussion on his paper, the "Sewage of London," at the Society of Arts—thus disposes of it: "If the 72 tons of sewage, so delivered to him for 15s., were to be in the state of dilution, which existing facts led him to think it would probably be, it would contain only about 7-8ths of the average annual excrements of one person, which, allowing liberally, he had valued in the solid form at 6s.; and however ardent an admirer Mr Mechi might be of water, he would perhaps agree with him (Mr Lawes) that the extra cost of 9s. or 10s. would be paying rather dear for the solution of 5s. to 6s. worth of manure." Mr Chadwick—we still take him as the exponent of the liquid distribution—however, takes objection to Mr Lawes' estimate of the average composition of sewage, and holds that it is at present much stronger, and that, by the extension of sanitary reform, it is possible the strength might be increased four times. Again, Mr Chadwick objects to the opinion that the chief value of the sewage is owing to the excrementitious matter of the population, and holds that it receives other substances of fertilising value, as soot from the roofs

of houses, animal excrements from the streets, and fatty matter from kitchen refuse. But Mr Lawes, in estimating the value of the sewage, did not overlook these sources of fertilising materials, but amply allowed for them. But as Mr Chadwick bases his opinion, that the sewage-water is actually stronger than Mr Lawes estimates it at, in the fact or supposition that the amount of dilution is much less than Mr Lawes takes it at, it is evident, we think, that if Mr Chadwick is to increase the value of his sewage by the addition of the soot from the roof, and the animal excrements from the streets, these being swept into the drains by the rainfall, he then runs the risk of diluting the sewage by this accession of water in a much higher rate than he increases the value by the addition of the soot and the animal excrement. Indeed, this accession of water to the drains due from the "rainfall," is one of the difficulties of the question; so much is this the case, that to get rid of it, Mr T. O. Ward—the well-known correspondent of the *Times*—has propounded the theory, "the whole of the rainfall due to the river, the whole of the sewage due to the soil." Mr Chadwick apparently bases his opinion on the assumption that this has already been done, and consequently argues that his sewage is more valuable, because the amount of dilution is less than it is estimated at. Thus he assumes that the average consumption of water is 12 or 12½ gallons per head per day. It is proved, however, that, according to parliamentary returns, the supply of water is calculated at 25 gallons per head per day, and that this amount is likely to be increased: in addition to this, authorities seem to agree that 25 gallons per head per day on an average is distributed by the rainfall alone. Taking Mr Chadwick's estimate of the cost of transmission of sewage to a distance of 10 or 15 miles, and to a level of 150 feet above the level of the sewers, at 2½d. per ton, to be correct, as well as his estimate that 12 or 12½ gallons of water is the average consumption per head per day, Mr Lawes well remarks, that "if Mr Chadwick would engage to supply the farmers with liquid sewage at 2½d. per ton in 12½ gallons, of which there would be, besides extraneous matter, in the average, the daily excrements of one individual of the population, he might venture to say that he (Mr Chadwick) need not be in want of customers. In this way the farmer would get upon his land, and in the liquid form, the annual excrements of one individual of the population for a sum of 4s. 2d." That this *cannot* be done, Mr Lawes, as well as numerous authorities, incline to doubt; that it has not yet been done, experience shows.

We have already stated that many eminent engineers dispute the correctness of the estimates which have been made by those who advocate the distribution of the sewage in its present form. But another point has arisen in connection with this department, for it seems doubtful—at least, the point is not explicitly stated

in the estimates—whether the cost of 2½d. per ton includes the cost of applying it to the land. Mr Haywood (Engineer to the City Commissioners of Sewers), who has had large experience, and whose opinion is entitled to some weight, has the following: "It was likely to mislead agriculturists if it was understood that sewage could be delivered on to land 25 miles distant from any point at 2½d. per ton. It was true that, in some cases, water might be raised 100 feet, and delivered a distance of 10 or 15 miles at 3d. a ton. But that was only delivered in bulk, and whether for household or agricultural purposes, it would only be on the edge of the estate or house where it was to be used. Now, it was the provision of the distributory apparatus and the cost of distributing which was the principal item of charge in irrigating land." Not farther to cite opinion of avowedly good authorities, we may state briefly that the cost of distributing liquid sewage appears to be much greater than has been yet estimated.

But another element in the question is yet to be considered,—the quantity required to be applied. On this point Mr Lawes has the following: "Mr Wicksteed, and the late Mr Smith of Deanston, supposed that about 150 tons of sewage would be sufficient for an acre. This, according to estimate of the bulk of London sewage, would contain less than the annual average excrements of two persons, and at 2d. per ton for the fluid would cost about 25s. In the instance given by Mr Cuthbert W. Johnson, the sewage was applied at a rate of that of eighty persons to the acre; this would amount to about 2450 tons of liquid per acre per annum, costing, at 2d. per ton, more than £20 for the annual dressing of sewage. But Mr Johnson thought that the area implied in these amounts might be reduced to one-third, and in this opinion Mr Chadwick concurred. At this rate the annual excrements of ninety persons would be put upon one acre of land, at a cost of more than £60. Mr Morse again estimated that the sewage of 1000 persons might be put upon an acre, which, reckoning the same rate of dilution, and the same price per ton for distribution as before, would amount to about £680 per acre. These calculations were, perhaps, sufficient to show what was the degree of probability that we should ever be able remuneratively to distribute the total sewage of London by a system of pipe drainage." We may here note, that Mr Lawes' own estimate is 10,000 tons per acre, which, at 2d. per ton, gives £104, 3s. 4d. as the cost of the application per acre.

There is still, however, another element of the question to be considered—the applicability of the sewage liquid to all crops. This is an important point, for it is to be considered that the outlay is in all cases the same, whether a large or a small amount of the sewage brought to the farm is used or not; whether it is applied to all crops, or to only one or two. Mr Chadwick says,

that it can be, and has been applied to all crops alike, cereal as well as grass, with great advantage. Need we say that he is at issue with many first-rate agriculturists. Mr. Chadwick maintains, "that the experience of Mr Pusey, Mr Mechi, and others, of the greatly-increased production of corn and root-crops obtained by dissolved as compared with solid manure, and the well-known physiological fact, that no plants take up their food in a solid form, were sufficient proof of the applicability to all crops of town sewage." On this point Mr Lawes states that he "must beg entirely to differ from Mr Chadwick as to the legitimacy of deductions' as to the *practical* and *economical* application of enormous bulks of dilute town sewage from any such data. The economisation of the area of distribution, so as to get the greatest possible concentration of produce on a limited area of land, was surely a main element in the economical application of the metropolitan sewage. And certainly no consideration of the efficacy of small amounts of fluid, applied at given periods of the year with special objects—whether these be the manuring of land previous to the sowing of corn, or the sowing of a crop during drought—was in any way admissible in this question, in which was involved the disposal not of a limited and discretionary, but of an enormous and constant supply of fluid, with a capital outlay equally great for the distribution, whether of a large or small amount." If a certain amount of manure is required to produce a certain amount up to a paying point, without over luxuriousness, where a much greater amount than this is laid on, it is either wasteful or prejudicial. Now, if to pay the cost of transmission of liquid sewage to a certain farm, a certain amount must be used, the crops to which it is peculiarly applicable must get too much, if the portion is really used which is not available for other crops; or if this available portion is not used, a loss is sustained in the extent of the outlay which, for great or small quantities, is still the same in amount. A parallel case may be drawn thus: Where a steam-engine is employed by a small manufacturer, if his business was of that extent as to enable him to use it all the day, it would pay him; but if he had use for it only one or two hours each day, he would inevitably lose by it. Again, another point is sometimes lost sight of, namely, that liquid sewage is not exclusively adapted to all lands of whatever kind. The agriculturist knows that mechanical bulk is required in some field operations as well as fertilising properties; hence the value of farmyard manure. And it is just probable that the value of solid manures obtained from liquid sewage, tested in some cases, owed their efficiency to this property of bulk.

On the opposite side of the question, however, much has been brought forward. Thus, some hold that liquid sewage can be applied to *all* crops, if proper care is taken in its application; theory as well as experience pointing apparently to the principle of apply-

ing it *prior* to the sowing—the land being of course previously drained, so as to obtain a porous subsoil. Mr Paine, a practical agriculturist, at the meeting of the Society of Arts already alluded to, cited some striking facts in support of this opinion. Professor Way also gave the following on this important point: "A great and increasingly acknowledged principle was, that they should manure the land, and not the crop. It was not necessary, even in the case of liquid manure, that the crop should be on the land when the manure was applied. He believed that there was abundant practical evidence to show that liquid containing manuring qualities produced its effects twelve months after its application, although it might be supposed to have run through before the crop was put in." The Professor has largely experimented on the subject, and has found that "soils removed nearly every particle of manuring matter from solutions which were filtered through them, allowing the water to run away and to leave the fertilising properties in the soil; and this proved that liquid manure might be applied to the soil without fear of losing the fertilising substances which it contained, although no crop was in the land at the time—a view of the subject which tended very widely to enlarge the opportunities for the application of liquid sewage manure."

We have noticed the dilution of the manure as deteriorating the value of the liquid sewage; but many agriculturists are of opinion that even in its diluted state it is worth applying at a considerable outlay. Mr Caird, the well-known agriculturist, on this point has the following: "If we took Professor Way's estimate of the solid and liquid excrements contained in London sewage, we would find it to be 1 in 1400. If that *one* was equal in quality to Peruvian guano, then 140 tons of sewage would supply as much manure as 2 cwts. of guano, with the water to wash it in besides. Now this quantity, at the price mentioned by Mr Chadwick, 2d. per ton, costs almost exactly the same money as 2 cwt. of guano, viz., £1, 3s. 4d. But the water was of very considerable value to a grass crop in the dry months of summer." And in answer to the objection, "Why not use the water which you would get for nothing on your farm, instead of paying for it?" he cites a trial which he instituted with horses, water-barrels, and tanks, in which he found that to pump, carry out, and apply the liquid at a distance of only 120 yards, cost 2½d. per ton. "Sewage at 2d. a ton must be cheaper; for if guano paid to be washed in with 100 tons of water, you had the cost of the guano.

Two cwt. of guano at 11s. 6d., ...	£1	3	0
Cost of applying 100 tons of water, by water-carts, at 2½d., .	1	0	10
	£2	3	10
Against 140 tons of sewage at 2d., ...	1	3	4
Showing a saving, by the use of sewage, of . . .	£1	0	6

This, however, as our readers will perceive, is taken upon the assumption that Mr Chadwick's estimate of cost of supply is correct; a point which, to put it in the mildest form, is doubtful. We have already, however, gone into this point.

We have as yet only discussed one of the plans by which it is proposed to use the liquid sewage of our towns. We have still to notice the other and remaining plan, by which the liquid is treated, so as to obtain from it the fertilising substances in a *solid* form. A few sentences, however, will dispose of this—for while there are many points of controversy in connection with the other plan of treatment, there seems a remarkable unanimity on this point, namely, that this plan of obtaining solid manure from liquid sewage is next to impracticable. On the one hand, in support of this view, we have the evidence of a very great number of trials having been made to obtain a valuable manure in this way, all of which have failed in giving thorough satisfaction: while on the other, we have the evidence of the analysis of eminent and trustworthy chemists, pointing to the same result, all of whom agree in stating, that if town sewage is to be applied to land generally, it must be applied in its normal state—that is, in the liquid form. Professor Way has stated "unhesitatingly, that any existing plan for the production of solid manure from sewage water would be a failure. He said this from a knowledge of the fact, that of the valuable matters contained in sewage water, nine-tenths exist in a liquid state; and these could not be separated by any known process of filtration, nor could they be precipitated by any substance which they had at present at command." And even admitting that the solid substances of liquid sewage were collectable without the use of any comparatively worthless material, the same objection holds against them which has been advanced concerning diluted liquid-sewage—that the cost of transmission would be a large per-centage on the original cost—thus preventing its paying even without taking into account its value as a manure, which would be comparatively low. For Dr Anderson's opinion on this point, we refer the reader to the paper "Proceedings in the Laboratory," in last number of this Journal, pages 199 and 200.

It is at this point the question of town drainage now stands. If the present system of tubular house-drains, leading to sewers, and these again to streams and rivers, is to be carried out, then it is clear that on the one hand we commit a great waste in an agricultural point of view, by throwing needlessly away that which beyond all doubt contains a comparatively large quantity of fertilising materials useful for certain crops; and on the other, we commit a great wrong in a social and sanitary point of view, by polluting our streams and rivers, poisoning the very sources from which we obtain the water useful for household purposes, or mak-

ing our rivers huge open cesspools, to flow past or through our towns, sending forth from day to day "the seeds of disease and death." But even supposing that the in-every-way absurd method of conveying our town sewage to river outfalls is discontinued, and plans adopted by which the liquid sewage is arrested in its progress, prevented from entering the river, and stored up, and dealt with either by pumping it directly on to the land, or treated so as to make it part with its fertilising matter in a solid form, still the present system of drains, necessitating as it does the use of water to make them efficient, presents difficulties which seem inherent in the system; for it is evident that the more the population becomes extended, and the farther the present principle—the conveying through the drains "*all* the refuse which can be estimated to float in water"—is carried out, the greater the quantity of water required, and the greater the decrease in value of the sewage liquid obtained. In view of these points, the attention of our first men of science has been directed to the carrying out of some plan by which both the agricultural and sanitary requirements of the question can be met. That some modification of the present system is desiderated, few are disposed to deny. Some—and the number is fast increasing—go further, and affirm that it is in principle wrong; that no modification of the practice founded on this will meet the difficulty; that we shall have to begin again—inaugurate another system, at least so far as the fæcal results of our population is concerned. We shall presently point out the direction in which the advocates of a new system are likely to lead—in the mean time we shall notice the most celebrated of the modifications of the present system yet introduced. This we have already adverted to as that of Mr T. O. Ward, who proposes to allow only the products of the "rainfall" to find their way into the rivers, through separate drains; these being distinct from those which he proposes to use only for the purpose of conveying the "sewage" of houses. In this way, by preventing the access of large bodies of water to the liquid sewage, its value is much increased. "If," says Mr Lawes, "the rainfall could be excluded from the sewage proper, a vast step would be gained towards the practicability of usefully applying the sewage of London." However desirable this modification of the present system may be, such are the difficulties in the way of carrying it out, that there seems little likelihood of its being adopted,—the scheme involving, as will be seen, a double set of drains and sewers. This, however, is but one of the many difficulties which environ the project. Thus, for instance, a very important objection is met with—important in its results, if Mr Chadwick's statement is correct—namely, that town sewage owes much of its fertilising powers to soot, as from the roofs of houses, and to manure, as from the roads. If so—this, however, as

we have shown, is disputed—then it is evident that this source of increased value is cut off so soon as Mr Ward's plan of keeping the rainfall separate from the sewage is carried out. Other modifications of the present system have been proposed, the nature of which may be gathered from the following remarks of Mr Adams, applying to London sewage: "Another outcry now comes, that no drainage is to be permitted into the river, but that all sewage shall be carried in closed sewers along the banks of the river, and be deposited in the marshes of Kent and Sussex. But this is simply removing the pestilence to a certain distance, to be borne back to us on the breath of the wind when setting towards us, or poisoning some other portion of the population in other directions. The next remedy is, to deodorise and dry the total collection in those same marshes; and here at last we arrive at something tangible. Owing to the bad construction of houses, and to our preference for small pipes, buried in walls and elsewhere, for purposes of secresy, and our use of water as a lazy, though not gratuitous carrier, we convert every cubic foot of excretion into many cubic feet of poisonous liquid. We may get it to the Essex marshes in that mode, but we have then to evaporate the water previous to drying and deodorising. Why, then, should we not begin at the beginning, and keep away water from it altogether?" In this direction, evidently, improvement in the treatment of the town sewage is tending, so far, at least, as the excretions of our population is concerned. For in the present state of our chemical and mechanical knowledge, it appears that we must still possess drains to carry off water used for domestic purposes; although, at the same time, we do not deem it unlikely that, in process of time, as we advance in knowledge, we shall be able so to treat even the refuse water of our kitchens as to obtain some valuable product from it. In various branches of our manufacture, chemistry has enabled us to convert what was at one time refuse into valuable matter. Indeed, the course of chemistry, as applied to the arts, is in the direction of utilising every product; and why not in the conversion of the waste materials resulting from our domestic arrangements, as well as in other branches of our social arts and manufactures?

The question of town drainage being thus narrowed to the point that water is not required to help us in getting rid of the excretæ of our population, we have to look around for some other aid. Obviously chemistry will afford us this, assisted of course by mechanical appliances, but these necessarily of a much more simple and inexpensive character than those now used in the present system. If, then, the purification of our towns, and the obtaining of a valuable fertiliser, is to be brought about, by chemical means, near the place where they are produced, rather than by mechanical transportation to some other neighbourhood, where a

nuisance is as likely to be made as in the place from whence they are carried, the question becomes one of vast importance, how the points involved are to be carried out.

The first grand object to be effected is the rendering the effluvia which would otherwise arise innoxious and inoffensive. Subservient to this, but still of vast importance, will be the appliances and the arrangements of our domestic structures to facilitate the storing up and removal to the land of the excretæ thus made inoffensive.

First, as to the chemical treatment. "As chemistry," says Mr Adams, "has been successful in converting filthy potato-oil and coal-tar (See Johnston's *Chemistry of Common Life*) into delicate perfumes, it is no doubt chemically possible to convert all the waste material of a household into innoxious and not unpleasant circumstances. Two considerations are requisite: first, that it be cheaply done; secondly, that it may not diminish the value of the materials as a manure, by locking up, as it were, the ingredients so firmly as to render them insoluble in the ground for the purposes of vegetation. . . . . To accomplish this is the business of the chemists. If the same skill and energy be put to work that has accomplished the conversion of other noxious substances into perfumes, we shall not long be at a loss." With these views we coincide: to say that the chemical, as well as the mechanical difficulties cannot be overcome, is but to libel the capabilities of the age. Attention is now being strongly directed to the getting of a disinfectant, cheaply obtained, and easily applied, and many have been introduced with comparative success: amongst these, none possess so remarkable properties as charcoal, a notice of which we now give.

A variety of substances which we employ as disinfectants act simply as absorbents. For a time the odours of the substances which they absorb are not felt, but the substances themselves remain unchanged, so that whenever the point of saturation is reached, the masses of absorbent material give out putrid odours. Nor is this all. The poisons generated by decomposition of animal and vegetable matter are also self-generating, so that when the point of saturation of the absorbent material is reached, the gases exhaled are in a highly concentrated condition. Sand, earth, cotton, wool, frequently used as disinfectants, act in this way. Lime, as a disinfectant, acts in a different way; it acts chemically, entering into combination with some of the products of decomposition. The most effective process however, in preventing, or rather destroying, noxious emanations from decaying animal and vegetable matter, is that of "oxidation" produced by bringing atmospheric oxygen in contact with the substances to be deodorised. Sawdust, ashes, and other light porous substances, by possessing large surfaces for a comparatively small bulk, act as deodorisers in this way;

but of all the substances with which we are acquainted, in the present state of the question, charcoal possesses the greatest power of condensing gases upon its surface. In this way it is "capable of bringing large quantities of atmospheric oxygen, in an active state, into contact with the noxious products of organic decomposition, and causing their destruction by an oxidising action." The sawdust, sand, gravel, as above stated, act as deodorisers, inasmuch as the interstices between these particles form, as it were, receptacles for air, through which the decomposing gases pass, and become oxidised by contact with the atmospheric oxygen. But all these substances are deficient in the valuable property which charcoal possesses in so remarkable a degree,—that of condensing gases on its surface. Whatever gases pass within its pores, then it is decomposed by the oxygen distributed in such large quantities over its minutest particles; and it is satisfactory to know that these noxious gases are never again liberated in a pernicious form. Dead animals, covered with a thin layer of charcoal, have lain for weeks in rooms, and not the slightest smell has been perceptible. At a lecture delivered at London by Dr Stenhouse, to whom the public is much indebted for drawing attention to this valuable substance, jars stood on the table containing dead putrescent bodies, from which not the slightest trace of an offensive smell emanated. But not only as a deodoriser, but as a disinfectant, is charcoal of high value. This has been clearly proved; indeed it is evident that, if it did not act as such, fever or other diseases would have resulted amongst those who habitually resided and transacted business in the rooms where the putrescent bodies lay, as above noticed. "During the last twelve months charcoal powder has repeatedly been most successfully employed both in St Mary's and at St Bartholomew's Hospitals, to arrest the progress of gangrene and other putrid sores. In the instance of hospital gangrene, we have to deal not only with effluvia, but also with real miasmata; for, as is well known, the poisonous gases emitted by gangrenous sores not only affect the individual with whom the mischief has originated, but readily infect the perfectly healthy wounds of any person who may happen to be in its vicinity. So that in this way gangrene has been known to spread not only through one ward, but through several wards of the same hospital." Not only in this way, but as a corrective agent, is the use of charcoal becoming rapidly extended. It is also becoming largely used as a purifier of sick chambers, a disinfectant of privies, and also for stables, cow-houses, &c. &c.

Here then we have a material which is admirably adapted for rendering the excretæ of our population at once innoxious and inoffensive, acting at once chemically and mechanically; in the latter as a medium or vehicle for storing up excretæ, and in the former, by freeing it from its noxious gases, absorbing and oxidising them. If it can be produced cheap enough, it evidently

affords us a means of obtaining a manure of a highly concentrated nature, containing all the valuable elements of liquid sewage, without any of the deteriorating substances associated with it found in the latter. Moreover, the manure is available in a form well calculated for removal, and possesses the property of bulk which we have already noticed as essential in a manure adapted for some kinds of soil. As regards the cost, it appears that the Nitro-organic Manure Company, Manchester, manufacture it at 30s. per ton, or 2s. per cwt., large quantities, at this price, having been used during the last five years.

Supposing that we obtain a "chemical neutral, cheap in itself, or at any rate of such a quality that it will possess an equivalent value when put upon land;" the next question to be considered is the means by which this "chemical neutral" can be made available, in consistence with domestic health and convenience—and by which *its use can be insured*,—an important point the latter, be it noted.

And here, with reference to the first point, it is to be observed that the new system will require new structural arrangements, where perfect efficiency is desiderated—not, however, that it is altogether inadmissible under present circumstances. But to do the system every justice, a new style of privy or water-closet arrangement must be inaugurated. At present we go upon a wrong basis; we look upon these as places which can be situated anywhere; the further out of sight, and the darker the corner, the better. We have long advocated a process the very reverse—knowing well the truth of the proverb, the "darker the dirtier;" we have felt assured that no thorough cleanliness would ever be effected in such places, unless they were placed in convenient positions and well lighted. There is no necessity why they should be placed in dark and out-of-the-way corners, or, with proper regulations and domestic conveniences, why they should not be cleanly and orderly. Indeed, it seems reasonable that if great attention was paid to it, even without any "chemical neutral," less chance of disease from noxious emanations would arise. It is from neglected places that we find the danger comes. Of course, with our thoroughly good "chemical neutral," every inducement would be held out to pay attention to this department, nothing offensive or unpleasant being connected with it. It is not the object of this paper to enter into details, showing how efficient arrangements can be made to carry out the proposed system. We do not conceive that any great difficulty exists on the point, or that the alterations or amendments in our present house arrangements necessitated, would be so great or so expensive as some seem to anticipate; on the contrary, we believe that, apart from sanitary considerations, this method of dealing with the

excretæ of our population would, in every way, be cheaper than the present costly system of house drains and street sewers.

As suggestive of methods by which the points desiderated can be carried out, we here give the plans proposed by Mr Adams and Mr Bird. "To use the disinfectants we need portable cesspools without the access of water in the ordinary plan of closet, in which cesspool or vessel the disinfectant may lie. It should be a vessel upon wheels, at a level with the yard of the house, and beneath the opening of closet or closets, with ample space, so that falling matter may certainly pass clear of the walls. . . . These cesspools should be furnished by companies, who would take them, with their contents, to discharge into the covered railway-waggons or barges, and replace them with empties. In this mode the material, undiluted with water, would be transported cheaply, and be as readily saleable as guano."

Mr Bird has designed for Government, for experimental trial at Aldershott, latrines or soil-pans to remove quickly all fæcal matter from the camp. These, more or less modified, are obviously adapted for many situations. The following is a description of their construction: "The cart and latrines are of wood and iron, each latrine being 5 feet long, 18 inches wide, and 2 feet 6 inches deep, and capable, when full, of holding about 115 gallons: there is a spindle at each end, fixed eccentric, and a movable cover to be used when the latrine is carted away for the purpose of being emptied. Previous to removal a yoke is attached to each spindle—the yoke having side-triggers, which preserve the latrine in an upright position, and admit of its contents being readily discharged. The cart is constructed on two wheels, having two arms projecting from the back, and resting upon the axle, with curved extremities adapted to the yoke. The shaft acts as the long arm of a lever, the axle being the fulcrum. By this simple contrivance one latrine at a time can be removed with great facility, without risk of overflow, and its contents deposited without any manual labour being necessary, either for filling or baling out." Some such contrivance as this would be well adapted for ranges of cottages at a farm steading, where charcoal or any other solid disinfectant was used. The bottom of the latrine might be so constructed as, by the slipping of a bolt, to fall and admit of the whole contents to be placed where desired.

Where the separation of the liquid from the solid portion of the contents of water-closets was desiderated, some such contrivance as the straining movable cesspool used in Paris might be adopted. This consists of a vessel placed upon, and communicating with, the interior of a tank; the vessel is supplied with an internal receptacle of less diameter; this is punctured with holes, which admit of the liquid contained in the fæcal matter passing into the vessel through

the soil-pipe draining through; this passes into the space between the two vessels, and finally escapes into the tank, through a pipe connected with the lower part of the outer vessel. When full it is removed—the contents being all in a solid condition—and another put in its place. The tank is provided with a pipe, through which, when necessary, the liquid is pumped.

As our readers are probably aware, the system of disposing of sewage matter in Paris is vastly different from the one we have adopted. It may be briefly described here. The major portion of the refuse water of houses, obtained from culinary and other operations, is passed to the Seine along open street gutters, these being fed by the channels from the various houses led across courtyards and foot-pavements. The fæcal refuse, and much of the slops, chiefly those of bedrooms, are passed into cesspools—these being either fixed or movable: one of the latter kind we have described above. The sewage is removed from these cesspools by Compagnies de Vidanges, who make a commercial speculation of the matter, and employ a large number of hands, aided by mechanical appliances. The cost of removal is paid by the tenant or proprietor, and varies in amount according to the district in which the house is situated, the districts nearest the place of deposit, where the sewage is prepared as manure, being charged the lowest. The sewage matter, after extraction from the cesspools, is conveyed, in the tanks into which it is pumped, to the *Voirie* of Montfaucon. For some hundreds of years this district has been used as a place of deposit for the filth of Paris: from the nuisance created by the emanation of noxious gases, which in windy weather are swept completely across Paris, a new Voirie has been established at the Forest of Bondy, some eight miles from the city.

The process of preparing the filth into manure is a very tedious and disgusting one. A number of basins—six at the Voirie Montfaucon—are arranged one above the other. The soil is placed in the two upper ones; the liquid portion draining off into the four lower ones. This is either passed into the chemical works, where the ammonia is extracted from it, or into the Seine, which is the case with the major portion of it. The mass in the upper basins, after three or four years, appears like half-liquid mud. It is farther drained by cutting channels across the mass; and, when sufficiently dry, it is spread upon the drying-ground, and turned over by means of a harrow drawn by a horse. Before being thoroughly dry, it is turned into heaps of large dimensions, standing in this way generally a year, but sometimes two or three. When the material is required as manure, portions are dug out, and broken into pieces, all extraneous substances being taken out: this portion of the business is effected by women. At this, the last stage, it appears "like a mould of a grey-bluish colour, greasy to the

touch, finely grained, and giving out a particular faint and nauseous odour."

From the mixture of extraneous substances, as well as from the tedious process of preparation, necessitating long exposure to the atmosphere, and consequent loss of valuable properties, our readers will perceive that the value of the manure will be materially lowered. M. Paulet, author of *Théorie et Pratique des Enquéris*, estimates the loss of the ammoniacal products contained in the fæcal matters, when they are withdrawn from the cesspools, by the time they have been ultimately reduced into poudrette, at from 80 to 90 per cent. Notwithstanding this deterioration, some idea of the value of the products of the Parisian cesspools may be obtained, when we mention that the quantity of poudrette sold in 1818 was equal to £22,400. All improvement is progressive. The steam-engine did not at once spring into existence, with its giant force and easy control; but, originating with the jugglery of priestcraft and the apparatus of the philosopher, it slowly assumed the form of Newcomen's clumsy engine, till the wizard hand of Watt endowed it with a new life, and made it the willing slave of man. Slowly creeping up weary hill-side, or through miry path, memory's mirror shows us our forefathers wending their quiet way; then dashing coachmen, with their spirited steeds, guiding the "mail" swiftly along smooth well-level roads; canals, with their glassy surfaces glistening amidst pleasant meadows, or spanning wild ravines—when our day-dream is broken, and we wake up to the realities of the world's present wonder, by the locomotive coming thundering past. So with all our social and physical improvements; and so with the important one—important in its physical as well as its social aspect—we have been noticing. Experience has in other matters been bought at great cost, and we must not expect to be relieved, in the matter of "town drainage," from the law which seems to have regulated them. And as we have witnessed the progressive improvements which have been made, each step of which necessitated, in a greater or less degree, the doing away with, or the total loss of previous attempts, so we doubt not that, if the spread of knowledge or successful experience would seem to dictate the necessity of carrying out a new system of saving the refuse of our towns—keeping up the balance of the waste of the towns, and the demand of the country—that all the expenditure we have been at will count as nothing, that the costly sacrifice will be made, rather than perpetuate a system which *seems* to be as wasteful as it is unhealthy. But it is unjust as it is impolitic to blame the agriculturists as a body with the perpetration of the present system of *non-usage* of the sewage of our towns. It is clearly their interest to use any material that will give them a return for their outlay, but they

cannot be expected at once to adopt plans merely on the dicta of certain authorities, and run all the risk of their being efficient or the reverse. In ordinary transactions the seller takes the material to the buyer, or he who is likely to become one; but if he does not take this preliminary trouble, he has no right to sit down and grumble that he cannot dispose of his wares. So in this important question. If the towns have, as some would persuade them they really have, a highly valuable matter which it would pay to convey to the country, it is clearly their interest to do so; and from the fact that it has not yet been done in spite of all the vigorous attempts made, it is not unreasonable to suppose that it cannot be done under the present system. We have had experience enough in speculative matters to show us that where there is a chance of even a moderate profit, no lack of means will prevent any project from being fairly tried.

But this, after all, is the very narrowest way of viewing the subject, so far as the towns are concerned. The paying point is not the only one to be considered; the social, the sanitary one, must not, cannot, justly or safely, be ignored. It is the duty of every people to get rid of that which is proved beyond a doubt to be the cause of great disease; nay more, it is their wisest policy and truest interest. We know that the refuse matter of our towns have a value in the country, and are dreaded while present in the town; we must, therefore, as communities dwelling in towns, make up our minds to take them to the country at whatever cost, placing what we receive for it, no matter how much or how little, against the cost of transmission. Should there be—which with a proper system there might—a balance in favour of the town, so far so good; if against, let them not grumble, but, on the contrary, perform the duty, and be thankful that they get something for that which, viewing the matter rightly, is a nuisance, and which they should be glad to get rid of at any cost. To "this complexion must *it* come at last," under any system, with water as a carrier, or without it. It will some day or other be imperative on every town to get rid of its sewage. The inhabitants will be wise in "their day and generation," if they wait not till the day of compulsion arrive, but begin now and endeavour to inaugurate some method by which they will convey quickly from the neighbourhood of their homes all refuse matter, and that so certainly and economically that they will get *some* return at least for it. That this can be done there seems no doubt; and that it can be done more certainly, safely, and economically than by the present system of drainage, not a few of our eminent men incline to think.

CHARACTERISTICS OF THE YEAR 1855.

By J. Towers, Ph. Ch., Croydon.

Preliminary Notice.—In order to keep the meteorological facts fresh in the memory, I have lately made it a rule to report each month retrospectively as it has passed. Thus, for instance, January taking the lead, its details are written down early in February, from the tables of my own diary, which comprise fifteen distinct columns. These are likewise *compared* with the scientific Lewisham tables, with which they generally accord. In future I shall simplify the readings-off of the barometer, thermometer, and rain-gauge. Thus, instead of writing in full the words *inches and cents*, the figures 30.15 will imply 30 *inches* 15 *cents*, or hundredth parts of an inch upon the barometric column; 29°.0 represent 29 degrees of Fahrenheit's thermometer, or 3 degrees of actual frost; and 0.75 inches will represent 75 hundredths ($=\frac{3}{4}$ths) of an inch of rain, or of melted snow. The above remarks, alluding to the decimal signs adopted by meteorologists, being clearly understood, it remains only to introduce the new year thus:—

January 1855.—This has proved a month of extraordinary contrasts. It might be divided into two nearly equal periods marked by the barometer, for on the first morning, at 8 o'clock, the mercury stood exactly at 30.0; it then ascended regularly, till, on the 10th and 11th days, it attained its greatest elevation, 30.52, from which it gradually fell to 30.0 on the 18th. The positions of the thermometer and of the wind require peculiar attention, and these compel me to restrict the *First period* (*a*) to the 9th inclusive. The mercury rose to an unprecedented height on each day; on the 1st, to 51°, on the 6th the same, and it never receded below 44°. Thus the average mean of the 9 days was 11° each day, *in excess*. The winds were westerly by south or north, and rain fell on the 1st, 2d, and 8th, to the extent of 0.13 cents only.

(*b*.) On the 10th the wind was in the east, with fog at 8 o'clock A.M., and at once it reduced the temperature more than 11°. Snow began to fall in the early morning of 15th, and continued so to do till the 18th, when the barometer had declined to 30. Here then we come to the

Second Period, when the frost of the winter was thoroughly established. The barometer had then fallen to 30, and on the 19th to 29.88. In its progress to the 31st night, when it marked 29.44, the mercury had fluctuated only a few cents. The temperature on the 19th was 23°, or 9° of frost. On the 19th my night-instrument stood at 16°, its lowest, while at Lewisham it was reported 3° lower = 13° Fahr. The entire period was frosty, but not severely

so. On the 19th the mean was 17°.3 below the usual average, and the deficiency of the *whole* period amounted to 133°.4, the diurnal mean 9°.5. Reviewing the entire month, I obtain the following data: Barometer here and at Lewisham, 30.107. Thermometric mean, 34°.80, by both tables. Rain or melted snow 0.92. The winds were westerly (chiefly in the early weeks) during 14 days; easterly by north or south, with very cold weather, during 14 days, and variable or calm on four occasions. Nineteen of the days were dry, but generally overcast. Drizzle or small rain on the 1st, 8th, and 14th, produced 0.14 cents of water, and *snow* fell on the 8 remaining days.

February will stand on record as the most consistently cold month of the name since 1814, to which references have been made by others. I, for one, remember many of that year's phenomena. The winter was long and rigorous, commencing with a very dense fog at Christmas. Snow of prodigious depth fell soon after, and this remained for weeks. A thaw of short duration intervened occasionally, but the cold weather did not fairly yield till April. Our present winter did not commence till the 15th, and its progress remained uninterrupted by rain till the middle of the third month, and so far only we venture to anticipate, and now to particularise.

First Period comprises 20 days, for on the 21st the wind deviated from its easterly course, by north-west to south-west. The mercury stood at a corrected average about 29.803 on the first day, it then receded to 29.26 on the 5th, and again fluctuated, rising to its maximum (29.99) on the 18th and 19th. The thermometer was low throughout; its lowest degree was noted at 11° Fahr. by me on the 19th, and at Lewisham 8°; the highest degrees were on the 3d and 4th (39° and 37°). The wind was chiefly north-easterly, very strong on the 2d and 8th. On the 16th to the 20th there was a piercing current from the east; air quite dry. A sharp shower fell early on the 3d, which froze on the windows, assuming the most curious forms; snow also fell on six occasions, with much injurious drifting. Being obstructed by, and sifting through hedges, it formed caverns and arches on the leeward sides, 6 to 10 feet high! The amount of water, whether by the shower, as sleet, or by melted snow, is reported by Mr Glaisher at only 0.67.

Second Period, 21st to the end.—The wind went first to north-west, then wavered, and settled at south-west, gentle in force, raising the temperature several degrees, and producing 0.28 of rain. The fall, added to 0.67, as above stated, gives a total of 0.95, or 5 cents under 1 inch of water during the course of this generally wet month. While speaking of temperature, it is worthy of record that so great was the depression that (excepting the 25th and 28th, when 3°.12 were plus) the average of the 26 days was 10°.3 *each*

day, which, multiplied by 26, give 26° in excess of the usual mean of this month. Several fogs, or rather mists, occurred at times, and on the 22d evening a lunar halo indicated the approach of rain. A decided thaw set in, and continued during 10 days, with occasional showers. In the course of February, my tables register 16 dry days, 3 with rain, 9 with snow or sleet, 10 overcast, 14 sunny, and 4 with mists. The barometric average of the month was 29.69; at Lewisham, 29.811. Easterly winds greatly predominated. From any quarter by the west they were only 8 days. The snow remained on the ground, yet, owing to the drifts, the corn in many places was not sufficiently protected.

March.—The meteorological phenomena of this critical month demand peculiar attention at all times; and on the present occasion they will be found most interesting, being interspersed among several irregular periods, the first of which comprises the four early days of the month, when the temperature was mild, the wind westerly, the barometer low, and the weather showery: the fall of rain amounted to 0.55.

Second Period, from 5th to 8th, both inclusive.—Wind south-east to east-north-east, gentle; some haze, clearing off before noon. Nights rather frosty; day temperature high, mean about 49°.0; no rain. The barometer rose from 29.70 on the 5th, to 30.11 maximum on the 8th evening.

Third Period.—Cold and winterly during an entire week. The wind chopped to north-west on the 12th, and remained westerly for a day or two. The temperature was greatly reduced, averaging 7° per diem; the lowest depression (12°.2) occurring on the 10th. The barometer marked 28.99 on that day, and rain fell. In this period the rain-gauge at Lewisham returned 0.45 cents. Much snow fell at Croydon on the 9th.

Fourth Period, 16th to 21st.—An amelioration occurred, and the average temperature advanced to 7° plus—that is, in the ratio of 1$\frac{3}{4}$° daily. The barometer was so low as to indicate changeable weather, and there was rain on the 16th, 18th, 19th, and 20th, but only to the measure of 0.27 cents.

Fifth and last Period commenced just as the sun entered the spring sign of *Aries* 7 minutes after 4 o'clock A.M. If we are authorised by attested facts and close observation to attach importance to the *equinoctial* intersection of the two great circles, some uneasiness might be occasioned by the following meteorological indications: Barometer 29.350, but rising; wind north-east; moisture of the atmosphere 96°—that is, within 4° of saturation; temperature of day and night, 39°.6—*i.e.*, 2°.5 minus; atmosphere overcast. The weather then became fluctuating; the moisture amounted to 100° on the 22d, and 0.28 of rain fell. Each night was frosty to the end of the month; on the 26th the lowest degree

was marked at 24° Fahr. The weather improved, for the 25th and 26th and 31st were fine and sunny. Sleet, hail, snow, and rain occurred at three intervals. As a phenomenon, the glowing red sunset of the 31st was perfectly magnificent. The characteristics of the month were—17 dry days, 3 with some snow, 11 with rain or sleet; prevailing winds easterly by north on 13 days, by south 4 days, south-west 6, west and north-west 8. The average height of the barometer with me, and also by the Lewisham tables, was 29.60, with scarcely any varying decimals. So predominant was the excess of cold, that after deducting the 15° of *plus* during 8 of the days, from the 126°.8 minus, there remain 111° of cold to be distributed among the 23 remaining days of the month = 4°.8 per diem.

April presents an extraordinary contrast when compared with its namesake of 1854; this will appear in the following statements. Its meteorology admits only of two periods.

The *first* was dry during a week. This was merely a continuance of the fine frosty weather that had commenced on the 29th of March. The period will also comprise the 19 consecutive days of the month, including the 12th and the 30th.

The *second period* begins on the 8th, and includes the 18th day. The little rain of the month fell to the extent of 0.8 of an inch, and if this very small volume be added, the 0.03 produced by a small shower on the 3d day, the reader will appreciate the extreme drought that characterised this reputed *showery* month of the advancing spring. The barometer averaged more than 30 inches, by my table, throughout the month, and also at Lewisham—namely, 30.044 according to Mr Glaisher, and 30.06 at Croydon—an almost inappreciable difference. The mercury stood below 30 on the 3d, 4th, 9th, to 14th; its lowest was 29.30 on the 10th evening. The thermometric averages by all the days and nights were with me—highest, 57.66; lowest, 34.56; mean of the two, 46.11. As reported by Mr Glaisher, the mean of the month was 45.7. Excess of cold, chiefly in the first week and during the 10 last days, amounted to 76°.7. On the contrary, the period of warmth between the 5th and 21st gave a return of 59°.5 *above* the usual average; so that 17°.2 excess of cold must be allowed. This, with the extreme aridity of the ground, may be viewed as one of the agencies which produced the tardiness of growth that we hear of from every quarter. The prevailing winds were north-easterly 10 days, after 17th chiefly, sometimes keen and fluctuating; north 3, east by south 4, south-west 6, in the second week, and west to north on 7 days. The greatest degree of frost was 27½ in the early morning of April 1st, but there was no severity of cold that could in any degree be compared with that of April 25, 1854, the influence of which had proved extensively destructive. During the course of this month our tables register 24 dry days, for the greater part brilliantly sunny, with-

out one drop of rain subsequent to the 13th. The grass pastures, however, retained much of their verdure, so did the young wheat and other cereals which had not suffered by the extreme force of the previous easterly winds. Rain in sufficient abundance to supply the springs and exhausted wells was the remaining desideratum.

May.—A month remarkable for its transitions. The first six days were dry and sunny, but cold. The barometer, at 30.10 on 1st, began to recede on the 2d, till on the 6th it stood at 29.95, after several intermediate fluctuations. The wind had been very keen from east by north, and did some injury to the young wheat on light blowing soils that had been reduced to ash fineness by protracted frosts. On the 6th the current became westerly, and rain approached. I had by that date supplied myself with an efficient rain-gauge, and thus ascertained that our immediate locality was refreshed by the absorption of 0.798 of rain between the 7th and 16th of the month. The Lewisham table reports rather more than 1 inch. The temperature remained far below the average to the 17th, the deficiency amounting daily to above 6°. On the 18th and 19th the barometer had risen above 30.0, the temperature above the average, yet both declined again. On the 24th, a bright and sunny day, the mid-day temperature rose to 70°; the night became cool, but the 25th was extremely hot at 77°. Again, on 26th, the thermometer rose to 80°—the average of three observations being 65°, equal to 10° plus. Strange to relate, with a return of northerly winds the weather became again extremely cold (38°), so far under the usual mean as to require a deduction of 9° each day. This is an extraordinary feature in a month whose average temperature is stated, on the authority of the *British Almanack*, to be 54°. Much as a cool and windy May is to be preferred to a hot one, a degree of cold so preponderating must always tend to retard the advances of agricultural produce. By comparison between our own and Glaisher's Lewisham tables, the barometric average of the month may be taken at 29.819, that of the thermometer 49°.35. Eighteen of the days were dry, many with sun; more or less rain fell on the remaining 13, the total fall here being about 1.69. The winds, from north-east, were forcible in the first week, also from the opposite quarter at its close, and varying to north-westerly during the following 10 days. The transitions were frequent and often abrupt, particularly after the 19th.

June came in with the greatly depressed temperature at which May terminated, and this continued till the 5th day. There was then a change. On the 6th the thermometer rose to 12° above the average of the period, the mercury rising to 84° of Fahrenheit scale, with the wind at south-south-east, according to the Lewisham table. Here, at Croydon, our instruments did not indicate a greater degree than 78°, the night for the first time marking 60°. The sudden transitions of the season, and the usual great depression of

night temperatures, produced that characteristic peculiarity which retarded the advance of vegetation to so late a period. Midsummer was at hand, and yet in many places the wheats were low in growth, and the spring-sown cereals scarcely visible. Prognostics of danger, if not of absolute evil, were hazarded; and the continued absence of genial spring-showers did not tend to meliorate the prospect. The rain of the whole month amounted to 0.61, and this slight addition brought up the return for the half-year to 7.23, being little more than one-half of the usual volume. Under these circumstances, connected with others of local interest, I was induced to devote attention to the rain-gauge and its indications; and after unremitting experiments I arrived at the conclusion, that the *square form* of the receiving funnel must be preferred, insomuch as the exact number of square inches can be correctly determined, provided the instrument be accurately made. Thus a funnel whose diameter is precisely 8 inches will comprise 64 square inches, whereas insuperable difficulties meet every attempt to estimate the number of square inches of water which pass through a circular instrument.

The meteorology of the month and its phenomena, may be thus arranged: Average height of the barometer, 30.05; of the thermometer, 58°.4, being the result of three daily readings—lowest 50°.1, highest 66°.86, being about $2\frac{1}{4}$° daily below the estimated mean. The cold periods were comprised between the 1st and 5th, 14th and 26th days. The prevailing winds were westerly by south 16 days, by north 7 days, and easterly to north 7 days. Rain fell, but in small quantity, on 9 occasions. Wheat came into ear on or just before Midsummer day, nearly 18 days later than in 1854.

July.—If the reader, after perusal of the following remarks, will take the trouble to refer to July in our Characteristics of 1854, a considerable difference will be observed in the arrangement of the weather phenomena. That month, in its early days, was unpropitious, and far from genial, the greater portion of its noted periodical rains having fallen within the first two weeks; but then fine weather set in, and that sunny and forcing temperature, so important to husbandry, was fully established, and continued throughout August, bringing forward and perfecting that glorious harvest, which perhaps more than rivalled its antecedent of 1847. So far retrospectively.

First Period includes 8 days, being a continuation of the same brilliant weather which commenced on the 19th of the preceding month. The barometer stood above 30 inches: the maximum day temperature averaged about 74°, and the nights were not cold. Hay-making was carried on in Surrey with great rapidity, and though the crop was trifling in bulk, the quality of the hay was superior. Those who waited for more grass (as a natural result of

the thunder-showers which established the rainy period of the four following days), lost their best opportunity. From the 14th the weather became unsettled, but the 15th proved one of the finest and most sunny days of mid July; and this circumstance may authorise allusion to the foolish superstition of St Swithin's day. "If it rain on that day, there will be rain for the next 40 days." The 15th of July now, does it in any way coincide with the 15th before the change of style? and would it not fall on the 27th, 12 days in advance? Has the saint lost his prerogative? for certain it is, that on our 15th, rain has occasionally fallen profusely, yet the weather has subsequently become all that could be desired for the safe housing of all the cereal crops.

Second or Wet Period dates from the 16th to the end of the month, with the exception of three fine days (20th, 21st, and 22d). Barometer at 30 plus, wind westerly, and with fine warm sun. Several thunderstorms and frequent profuse showers followed, and thus, instead of enjoying the fine maturing weather of 1854, the advance of the harvest was again materially retarded.

Instrumental observations at home, compared with those reported, give the following results: Barometric average of the whole month, 29.9: Thermometric mean, 61°.4; maximum of the days, 72°.4; minimum by night, 56°.5. Winds—between south to west, 17 days, chiefly after the 12th; north-westerly on 6 days interspersedly; north to east 4 days, and thence variable on the 6th, 7th, 8th, and 9th. The mean temperature of the entire month coincided pretty nearly with that of the ordinary average of July. The total quantity of rain measured by my own instrument amounted to 6.26: the balance was thereby restored. The Lewisham table reports 5.36; and these differences must take place whenever the rainfalls are produced by heavy local showers. Corn was partially laid, and I observed some evident marks of a *current*, indicative, I conceive, of electric agency between the earth and atmosphere, as the corn stood erect and firm on each side of a narrow strip extending more than 200 yards.

August came in as July had terminated, and retained a similar threatening aspect till the 9th. There were many showers, and only three of the days were quite dry (1st, 3d, and 5th)—the volume of rain gauged here was 0.73; that at Lewisham 0.67. In this *first period* the barometer fluctuated between 29.70 and 30. The average temperature was 1° below the usual one of 62°, and the winds from west to south were frequently very brisk. Under these circumstances, combined with trustworthy reports of wet and unfavourable weather on the Continent, solicitude concerning the future harvest—already late, but advancing to maturity—began to prevail. On the 9th evening, however, the mercury rose to 29.95. The *second period* commenced on that day, and with it the fine weather commenced, which forced on the harvest

with rapid strides. It continued without interruption to the close of August, unless we view as such the glorious electrical phenomenon which commenced in East Surrey about 8 o'clock in the evening of the 23d, and ceased rather before dawn of the 24th. After a powerful sun and sultry heat of nearly 80°, thunder-clouds formed, and two or three distant peals were heard at Croydon; but the storm passed off, and the clouds separated at sunset, with fine clear spaces between them. At 8 o'clock flashes of lightning commenced in the south-east horizon, and these recurred more and more frequently as the rocky masses of clouds extended to the south and south-west. The coruscations were brilliant in the extreme, and were responsive to each other, as they blazed from various masses that continued to form in the western horizon. No thunder was heard, nor did any rain fall. It appeared, in fact, that the strife was entirely atmospherical between the two electricities, for although there were many *streams of fire*, yet all appeared to *ascend* in the cloud, not one darting, as forked lightning, toward the earth. The display continued without intermission till nearly 1 A.M., when the clouds, converging, as it were, in a centre, thunder was heard, not loud, and in distinct reports, but as a continuous roll in sound, resembling that of a heavy wind, protracted for at least fifteen minutes: thus the phenomenon terminated before 2 o'clock A.M. Rain accompanied it toward the close, and I ascertained by the square rain-gauge that the fall amounted to 0.67 of an inch—a valuable supply for the mangel-wurzel, swedes, turnips, and grass pastures. No injury was sustained by the cereal crops, which were harvested with great rapidity, and were nearly all secured by the 31st. The meteoric and instrumental averages of August may be comprised in a few lines. The winds N. and N.W. 7 days, S. and S.W. 18 days, S. and S.E. 4 days; the 11th and 18th were calm. Twenty-five of the days were dry, chiefly after the 8th. Showers fell at Croydon on seven occasions, producing 1.40 of water: the greatest fall above alluded to was entirely local, as accounts received subsequently, proved that even at small distances the fall of rain did not amount to 2 inches. The average of pressure was taken here at 30.02: of the thermometer, 62°.7. Thus the mean of the entire month was in excess of about 1°.1.

September.—This has proved the most important month of the year, inasmuch that it witnessed the conclusion of the harvest under circumstances the most benign and propitious. Conflicting opinions of the quality and yield of the cereals exist to a great and painful extent, and sad exaggerations have been indulged in by parties whose object appears to be the advance of prices at the expense of truth. Time must determine the questions of supply and demand. At present it will suffice to enter upon a strict recital of the meteorological averages of the month. The barometer was high

throughout: its greatest altitude at Croydon was 30.44 on the 7th, 8th, 24th, and 25th days. The mercury fell below 30. on the 27th, and at 10 P.M. receded to 29.83, the mean of the month being 30.118. Much rain fell in the last four days, amounting to 0.578. By comparison of the total fall noted here, at Camberwell, and at Lewisham, I obtain the following results: 1.02, 1.10, and 1.10, a striking and peculiar coincidence. The thermometers in several places varied considerably—particularly in the morning's reading-off; my lowest point occurred on the 27th morning, early—37° Fah. Mr Glaisher's register gave 29°.7 = 2°.3 of frost. Vegetation, however, bore no indication of actual frost. The mean temperature of the month, from three daily observations, was 57°.50—a little below the usual mean. There were 22 dry days, and 8 wherein more or less rain fell near Croydon. The winds came from an easterly point: in 22 of them from east to north. The westerly breezes (chiefly in the third and fourth week) introduced those seasonable rains that produced a rapid enlargement of the bulbous crops, chiefly of the "mangels;" the cultivation of which root is much on the increase.

October.—An entire month of alternations, and perpetually recurring meteoric and atmospherical changes. After the 26th of the preceding month a rapid depression of the mercury took place, and from 30.21 inches the barometer fell to 29.43 inches. Rain then approached, and between the 1st and 7th of October I gauged 1.135 inches; the Lewisham table reports 1 inch 36 cents. These copious rains were useful: they promoted the verdure and growth of pasture-grass, benefited the August turnips, and restored the balance of volume, which had been much disturbed by the aridity of 1854, protracted till July last. There were 14 days without rain, 11 of them sunny; all the others were more or less showery. The prevailing winds were south-westerly — sometimes stormy, as on the 25th and 26th. In the last week, north and north-east winds reduced the temperature several degrees below the average (47°). The month, on the whole, was not cold, for, as 16 of the days produced an excess of 59°.3, the minus of the other 15 amounted only to 33°.5, — the difference (25°.8) being equally distributed, yielded an average excess of heat somewhat under $\frac{4}{5}$ths of a degree per day. The greatest night-cold occurred on the 15th (36°), when the average was reduced to 6°.3 minus.

The subject which excites at this time a very deep interest is the great price of bread. Two successive harvests have been abundant, and perfectly secured. The distress produced in families with limited means is heavy, and much to be lamented; but where and what is the remedy?

November has exhibited peculiarities; but, on the whole, farmers speak well of it as seasonable. In good truth, they have had no reason to find any fault, for the land had been brought into the best condition for every operation, either prospective or as con-

nected with realisation. Meadows and pastures had assumed the verdure of spring; the plough was kept steadily at work; much seed was sown; and now, on this 7th day of December, I have observed the green blade in the drills, not lush or winter-proud, but healthy. What the public has just cause to deplore and complain of, are, the inadequacy of drainage and the too shallow depth of the staple. Were deep tillage effected by some cultivating machinery—say to the full extent of 10 or 12 inches, always excepting a hungry gravel or vicious pan—the country might certainly add one-fifth to its produce. Does not the experience of the Yester deep land-culture bear out the suggestion?

The root-crops claim particular notice. White turnips have not recovered from the torpor induced by the aridity before alluded to, and therefore are locally deficient. Swedes are better, and many are stored. Late in the month there were specimen bulbs of enormous bulk and singularly fine regularity of growth. But the mangels! what can be said of *their* amazing quantity? And as concerns the orange-globe variety, its yield and quality are altogether surpassing. Everywhere we meet with immense stores, protected by deep ridges of earth piled to the height of many feet, and ventilated by orifices, which are carefully closed with light plugs of straw. Every one seems in accord upon the character and value of this excellent nutrimental "root of *plenty*."

The meteorological data of the month remain to be noticed. The barometric averages from two daily readings were 29.994 inches; the highest, 30.33 inches on the 26th, the lowest on the first 3 days, and never below 29.60 inches. The total averages of the thermometer by three observations were—lowest by night, 36°.55; day maximum, 45°.66; 10 P.M., 40°.4. The winds were north to east on 14 days, east to south 3 days, south to west 8 days, and west to south 5 days; sometimes lively, but never violent. The sky was generally overcast, but 9 of the days enjoyed more or less sun. Rain fell, by my observations, on 11 occasions, and to the extent of 1.595 inches. At Camberwell the fall was reported at only 1.24 inches, and at Lewisham 1.50 inches.

December.—The weather proved so changeable throughout (with the exception of the week commencing on the 15th) that it would be difficult to divide the month into regular periods. It commenced with 1° of frost in the early morning, hazy; the barometer at 30.08, rapidly falling to 29.84, the day sunny. Drizzle succeeded to this more or less, and on the 2d, 3d, and 4th, it produced on the whole nearly 5 cents of water. The 5th day was fine and rather genial—41° and 42°. In the night there was the first sprinkling of snow; not sufficient to cover the fine green herbage. It did not, however, melt away or wholly evaporate, though several sunny days occurred between the snowy intervals, and the great change in temperature of the 14th at 10 P.M. The keen frosts of every

night, from the 6th to the 14th inclusive, will account for this. The wind had then veered to the west, and brought with it 17° of increased temperature, between 8 A.M. and 10 at night. Then a drizzling rain commenced, which produced, by my square gauge, 0.11 of water on the 64 square inches. The thermometer, by 3 daily observations, gave about 36° average to the 17th day. A lull on the 16th, followed by a change of wind to east, introduced that severity of frost which has been generally noticed as extraordinary and unwonted at so early a period of winter. My self-registering instrument marked 14° Fahr. on the 22d morning. Eight following days were frosty throughout, and they terminated in the evening of the 22d, when one of those extraordinary transitions of this season claims particular notice. On the 23d, early, the register was read off at 24°.8 of frost: by 2 P.M. the mercury had risen to 45., the wind being south-west. Rain commenced during the night: more fell on four occasions, and finally, as a sudden shower, at noon of the 30th. The total volume gauged was 1.399 during this period of 9 changeable and warm days, wherein the mean temperature greatly exceeded the usual average of December.—It remains to describe the meteorological phenomena of the month. The barometer here averaged 29.839. The two thermometers gave—minimum of all the nights, 31°.36; maximum of all the days, 39°.35. The winds came from south-west to west on 11 days, chiefly in the 3d and last weeks; from west to north on 7 days, on the 1st and 2d weeks; from north to east 3 days, and from east to south 5 days: calm twice. In force the current was occasionally lively, but it became violent on the 26th from south-west. As respects the weather, 14 of the days were dry, with more or less sun on 10 of them. Rain, sleet, and snow fell on the remaining 14 days. The rainfall of the month is estimated at 1.711; that of the whole year, 24.17 inches. When we take an extensive standard, and compare those of Greenwich and Camberwell, the general return may be safely estimated as somewhat below the yearly average rainfall in the metropolitan counties.

Phenomena.—Two or three beautifully-tinted circles were observed near the moon in the third week. At sunrise on the 30th the clouds assumed many fanciful groups of light yellow-tinted cumuli, or vaporous masses, extending from south-west to north-west, while the rising sun illuminated the cumuli in the south-east with a pale silvery lustre, from the centre of which darted numerous black rays at various angles, the outermost extending about 60°. The phenomena were indescribably impressive.

The agricultural prospects are encouraging. May a bountiful Providence sanction the promise, and, with an abundant realisation, confer the further blessing of gratitude and thankfulness.

January 1, 1850.

THE FARMERS' NOTE-BOOK.—NO. LI.

Remarks on the Hereditary Properties of Cultivated Plants. By DAVID GORRIE.—Plants brought from other climes retain, at least for a time, the peculiar habits they may in these climes have possessed, although they are removed from former influences. Thus the sweet-scented coltsfoot, accustomed to flower in the winter time in the mild climate of the south of Europe, will not cease attempting to rear its flowering heads whenever encouraged to do so by a week of fresh weather in the middle of our own winters, however often it may have received, from our winter's frosts, a lesson to the contrary; and the same may be said of many other exotic winter flowerers, whether their place be in the greenhouses or open gardens of Britain. And, brought from a severer clime, where, however, the spring is sudden, and uninterrupted by returning frosts, the Siberian crab with us continues to put forth its blossoms with the first breath of returning spring, although experience might have taught it the danger of so doing in a country where a return of the cold north wind in course of the spring months often "checks all our buds from blowing." Even annual plants show an attachment to habit; and though in their case it cannot be expected to last over many years, each year witnessing the growth and decay of a generation, still the farmer knows that, by bringing his seed-corn from a warm sandy or gravelly soil, the soil he cultivates being of a colder nature, he will succeed in having an earlier harvest, the seed being the produce of plants that, from the influence of soil and climate, have acquired a habit of ripening earlier. Only, as corn is shortlived, he must continue making this change of seed to perpetuate the wished-for benefit. It is for the cultivator to take advantage of the fact that plants, like men, are "creatures of habit."

The habits of plants are more or less hereditary, and the same may be said regarding certain of their properties. Thus it is a property of an inferior variety of the Scottish pine, too much planted in the lowlands, to have white and inferior timber; and when seed is gathered from the lowland woods, the comparative worthlessness of the variety as a timber tree is perpetuated. But seed of the true badge of Clan Alpine, the real native pine, gathered in the forests of Braemar or Strathspey, produces trees having red and durable wood; and yet the two kinds, differing as they do in the properties of their timber, are but varieties of the same species of pine. One sample of flax-seed will produce a fine-fibred flax, while another will produce flax with a coarse fibre, there being all the time no difference in species, or even in variety, but only a difference in the soils or climates where the two samples

of seed were raised, the soil and climate of the place where they are sown having also a relative influence. A variety of wheat liked by the baker from the thinness of its bran, or from some other reason, will in all likelihood, when sown, produce wheat excelling in the same particulars; and the same may be said of varieties of barley preferred by the maltster, and of oats held in special esteem by the Scottish meal-miller.

When a cultivated plant has developed a peculiar property esteemed valuable, it is of importance that such property should be perpetuated. There are hindrances to this in the tendency of cultivated plants to sport or to cross with others of their kind growing near them. Hybridisation as an incident of culture was known thousands of years ago; and to guard against it, as sometimes having an injurious effect, the inspired lawgiver of Israel forbade the sowing of a vineyard with divers seeds, lest its fruit might be polluted; and there seems to be a spiritualised allusion to this injurious effect of allowing an intermingling of good and inferior varieties of cultivated plants, in the remarks divinely made regarding ancient Israel, when it was said that they had become "the degenerate plants of a strange vine," though they had been sown "wholly a right seed." They had mingled with the heathen, and thus had lost the marks that should have characterised the children of Abraham.

But though hybridisation, as effected by the agency of insects or of the wind, on plants of a like botanical nature yet differing in their habits or properties, may often cause injury and pollution, the art of hybridising plants, and of crossing between varieties of the same species, may often prove highly useful to the cultivator. Sometimes superior varieties are in this way obtained accidentally, or without the agency of human art, as when a marked ear of corn is picked in a field, and its grains preserved and sown. The produce of such grains will be found to manifest a likeness to their original. Thus the Sandy oat, originally discovered by the herd-boy Sandy Tamson, maintains the persistency of its grains, these being difficult to thrash out, or to shake out by high winds in autumn; the potato oat, where preserved pure, shows fine plump grains, easily shaken out when ripe, as in the first ears found in a potato field; the Annat barley is still a favourite with the maltster, and shows a beautiful well-filled grain, where it has been preserved from mixture, and sown on a suitable soil; for this barley, liking a dry warm loam, soon deteriorates on a strong clay, and has not, like the Chevalier, the ability of adapting itself to various kinds of soil; and then, as for wheat, some kinds originating also in an accidental way, have maintained their character for a long time, while others, from having been mixed, or taken to unsuitable soils or climates, have gone out of repute.

At present it seems to be a disputed point whether seed of the

very finest quality should be sown in order to produce good grain. The general opinion hitherto has been in favour of this mode of practice, and agricultural societies have been in the habit of awarding premiums for the finest samples of seed-corn, without considering that such samples may owe their superiority in weight and colour, partly to the influence of a favourable climate or season, and partly to the mere mechanical agency of a good set of *fanners*, to which the grain may have been twice subjected instead of once. In endeavouring to improve established varieties of wheat or other grain, it has been thought commendable to select in the field the largest plants or most fully developed ears, and in the barn, the largest, roundest, and best-coloured grains. And yet, in entire opposition to the principle which guides this mode of acting, it has sometimes been found that seed-corn of inferior quality, even when it has been damaged by frost or badly secured in a wet harvest, produces grain of excellent quality, while seed of first-rate quality has produced grain of moderate weight and bad colour. Such contradictory facts may be attributed to the varying influence of the seasons; but it would appear, after taking a view of the whole, that it is not essential to have the seed of very fine quality in order that its produce may also be superior. It would appear, rather, to be true, that highly cultivated, finely filled, and well-matured grain, however well fitted it may be for grinding or malting, has a degree of inertness about it which is unfavourable to propagation.

To arrive at any satisfactory conclusion on this subject, a distinction must be made between those good qualities in seed which are only brought out under favourable circumstances as to climate and soil, and those properties which inherently belong to a plant and descend through its seed to its offspring. Thus if roundness of grain be the result of fineness of climate, a colder climate, in the case of wheat, will cause the grain to lengthen and lose its fine shape; and it is the same with colour. As for the oat-plant, which has been fitted by its Creator for the comparatively cool and moist climate of Scotland and the north of England, if a fine well-filled sample be taken as seed to the south of France, the produce will be thin, shrivelled, flinty, and such as a Scottish miller would not look at.

Formerly it was thought that, with the exception of flax and potatoes, seed should be brought from a better climate to one that is inferior. Lowland farmers brought their potatoes for planting from the muirlands, and Dutch flax-growers brought their flax-seed from Riga; but Scottish farmers thought it best to procure their seed-wheat from England, finding that it brought with it from the earlier climate of the south, a habit of earliness. But fine English wheat-seed is now, perhaps, less in request than formerly; for its beauty of shape and colour is the effect of climate—it has fine

qualities, but they are not hereditary—and a few years in the climate of Scotland takes off the English gloss.

Plants forced to a high state of culture are liable to become degenerate. Wheat, in its native countries—in Sicily, for instance—will grow year after year when self-sown, and still grow as well as at first; but in Britain it is an exotic, and also removed by culture from its natural habits, and, without a change of seed and of soil, it will change in character for the worse. High cultivation may result in degeneracy both in the plants of the farm and those of the garden. In florists' flowers this is seen most visibly. The heartsease violet of the florist is shortlived compared with the old *Viola tricolor* of the flower-border. The double sweetwilliam becomes a biennial, and is sometimes propagated with difficulty from cuttings. When fully double it ceases to bear seed, its stamens being converted into petals; and it is the same with many other double flowers. Many budded and grafted shrubs and trees are short-lived, whereas their wild congeners live and flourish for many years. The potato has been so forced by high culture as to become a degenerate plant. And as for cereal grains, perhaps the fineness of quality in a sample may intimate an arrival at the limits of perfection beyond which the arts of the cultivator cannot lead them, and, arrived at which, a change of circumstances for the worse will cause rapid degeneracy. If, then, seed-corn is to be preferred for its mere fineness of quality, it should be sown in a climate and soil equal to that in which it grew. And if a farmer occupies a cold wet soil, and still wishes to purchase and sow a change of seed of excellent quality, he should improve his soil, and even alter his climate, by—in short—"*Yester Deep-Land Culture.*"

Mr Stephens, in his very interesting little volume bearing this title, describes Yester culture and its effects. The Marquess of Tweeddale prepared his soil ere he began his experiments on the best way of improving and perpetuating the hereditary properties of wheat and other grains. The object of the Yester experiments with wheat differs from that of farmers who seek the largest return from the acre of the kind of soil cultivated by them, whether or no the variety they cultivate may be the best fitted for making bread; unless, indeed, such variety be decidedly objected to by bakers, or can only be used by them as a mixture with other kinds. In this way, the culture of the "blood-red," a favourite variety, was limited, because bakers found it necessary to mix it with foreign wheat, or with white wheat home-grown. Mr Stephens remarks, in reference to the proposed experiments at Yester:—

"Both millers and bakers prefer the foreign soft wheat to our own, not because it is cheaper—for it is dearer—but because its properties are such as are admirably fitted to make a larger quantity of better bread than our own varieties. It is on this account, and no other, that the fine varieties of foreign wheat realise a con-

siderably higher price—perhaps not less than from 5s. to 10s. a quarter—than the best wheat of home growth. Our own wheat, of the inferior crop of 1853, was so bad as to make bread that was scarcely edible, while inferior foreign wheat, of that crop, made comparatively good bread. Now, when things are so, it seems incumbent on the growers of wheat of this country to investigate the grounds of preference shown by our bakers aud millers for the foreign wheat; to ascertain whether our own varieties of wheat are capable of assuming similar characteristics to the foreign by an altered mode of cultivation; or whether it would be better to introduce a foreign variety into our culture from abroad, possessing its already marked characteristics."—(*Yester Deep-Land Culture*, p. 144.)

This is an important object to keep in view. As regards foreign wheat, the main difficulty will be to get it to preserve its superior properties in a changed soil and climate. Yester draining and deep-ploughing offer to bring even a very inferior soil half-way to meet the requirements of foreign wheat-seed. Wheat already comes to the Haddington market from the Yester farms, of a quality that commands the highest price, although grown at an altitude and on a soil where, a few years ago, the culture of wheat could not be attempted. The only natural benefit enjoyed at Yester previous to recent improvements, was the dryness of its climate, as compared with moister localities on the opposite or western side of Scotland.

There are things connected with the practice of agriculture which can only be learned by experience. A new variety of grain might be analysed; and a chemist might tell whether its good quality and fine shape were or were not conjoined with a large per-centage of protein compounds, or of blood-and-muscle-forming matter; but the variety cannot meet with final approval till it be seen how it turns out in the barn, and how it takes the market; and, further, how it accommodates itself to different kinds of soil and climate. And, however much chemistry may teach us regarding the nature of soils, the experience of the miller and the maltster becomes the safest guide in fixing the rates of the grain market, seeing that, besides taking into account the weight of the bushel, the buyer should know the name of the farm where the grain was produced. And even on the same farm soils may differ so much that an oatmeal-miller will not give so much for 43 lb. oats from one field as he will give for 43 lb. oats from another. The one cargo may *meal* better than the other, though the weight be the same.

As for the improvement of turnips and beet, experience can tell us much that science leaves doubtful. It has been proved that their specific gravity is a hereditary property, and not a mere accidental quality. In the case of the sugar-beet, an excess of that property indicates an excess of saccharine matter; and hence, by

planting selected beet-roots for seed, French cultivators have greatly increased the amount of sugar obtainable from a given bulk of roots. The experience of the cattle-feeder tells him that, whatever the cause may be, turnips excelling in specific gravity tell the best tale in the feeding-byre.

Were seed-turnips selected on account of their largeness of size only, their progeny would most likely become degenerate—size being an accidental habit induced by high culture, rather than a native property. To judge by shape, colour, and specific gravity, on the other hand, is to take notice of properties that may be expected to descend to the next generation.

On the Action of the Nitrates of Potash and Soda on Vegetation—(Translated from a Memoir read before the Academy of Science by M. Boussingault).—Saltpetre exercises a most favourable and decided action in the development of plants. This property of it was not unknown to the ancients; and the reason of its not being generally used in their agriculture, is the high price which it brought in those countries at a distance from its production, owing to the great expense of transport, and often to the very heavy import duty. Thus the application of saltpetre for the amelioration of the soil only became a part of farm practice after the discovery of very rich beds in Peru. This discovery was known in Europe in 1821. The analysis of the nitrate was made first in the School of Mines at Paris, by a young Peruvian, M. Mariano de Riviero; and it was one of the most illustrious members of this Academy, the Abbé Haüy, who determined the form of crystal.

It is found in the province of Tarapaca, situated between the 19th and 22d degrees of south latitude, in an arid plain, amongst a mass of the nitrate of soda, of sea salt, and of the borate of lime, about 8 or 10 leagues from the coast.

Deposits of saltpetre are also found in the Pamba del Tamaragual, at an elevation of about 1000 metres* above the level of the Pacific Ocean, amongst alluvial deposits, conglomerates, and fossil wood of very recent date. These beds, which are considered inexhaustible, extend to within 6 leagues of the coast; beyond that limit the nitre is replaced by sea salt.

The Peruvians designate the nitre mixed with sand and clay by the name of *caliche*. The white crystallised caliche is pure saltpetre, and at certain points it is so hard and compact that it is necessary to use it in a state of powder in working with it. The caliche is deposited in beds of from 2 to 3 metres in thickness, and from 80 to 400 metres in length. To separate the nitre, it is treated with boiling water; the solution is evaporated by a fire or the heat

* Metre=3.281 feet.

of the sun; and when the salt is dry, it is carried to the port of Iquique, whence it is shipped to Europe and the United States. According to M. Riviero, the value of the nitre at Iquique, delivered by the manufacturers at Tamaragual, when there is a demand for it, is about 25 francs the 100 kilogrammes.

The working of the saltpetre beds in the province of Tarapaca did not commence earlier than 1831; in the last five years the exportation has exceeded 3 million quintals.

It is remarkable that, before the conquest, the Peruvians derived no advantage from nitre; nevertheless, the Incas possessed a most advanced knowledge of practical agriculture. The attentive observation of the circumstances which attend the lowering of the temperature by nocturnal radiation had taught them to preserve their fields from the effects of cold, by disturbing the transparency of the air by means of smoke; they applied guano to the soil, they prepared an active manure of dried fish, and from nightsoil they made a poudrette, which they applied in small doses to the roots of every plant of maize.

The good effects of the nitrate of soda on crops, which received from 120 to 125 kilogrammes per hectare, were called in question till the comparative experiments of David Barclay in England, and of Kuhlman in France. And we can affirm, that of the large importations of nitrate from Peru into Great Britain, the portion used in agriculture, though now very considerable, is still on the increase.

It being once established that the nitrates of potash and soda contribute much to the vigorous growth of plants, it only remains for us to consider how they act. Do they act as alkaline salts, which are always so efficacious on vegetation? or, by reason of their compound nature, do they act after the manner of the manures derived from animal substances—as, for example, the salts of ammonia? These questions are certainly of importance, and it is with the hope of aiding to solve them that I have instituted some experiments, the results of which I present in this memoir.

The only explanation which I know has been given of the useful effects of the nitrates on vegetation, is that of Kuhlman. That skilful chemist, relying on the interesting researches which have established the fact of the production of ammonia by the action of hydrogen in a nascent state on nitric acid, has arrived at this conclusion, that when the nitrates occur as fertilisers in the soil, their nitrogen, before being absorbed by the plant, is transformed most frequently into ammonia in the soil itself. It is sufficient then, adds M. Kuhlman, to obtain the full value of the nitrates, that these salts be placed under the deoxydating influence of a putrid fermentation, of which the definite result will be the carbonate of ammonia. It is to be regretted that M. Kuhlman has not investigated whether the organic matters in the progress

of putrefaction really convert the nitric acid of the nitrates into ammonia. That investigation was so much the more necessary, as we know with what facility the constituent nitrogen of ammonia is changed into nitric acid. It is even on this tendency to oxydation that is founded the most plausible theory of the nitrifaction of a soil, where are brought together the animal matters and the alkaline bases.

I have thought it then proper to examine if the presence of putrefying organic matters in the soil is indispensable for the nitrogen of the nitrate being assimilated by the plant; for in the case where assimilation takes place in their absence, we are at liberty to draw two conclusions: 1st, That it is not necessary that the nitrogen of the nitric acid be previously converted into ammonia in the soil, before becoming fit to be assimilated by the plant; 2d, That in their effects on vegetation the nitrates do not act solely as salts by means of the base of potash or of soda.

The process which I adopted consisted in making a plant grow in sand rendered quite sterile by calcination, adding to it a known quantity of an alkaline nitrate and ashes. The watering was done with pure water. In the case where the plant was fully developed, it was necessary to make an analysis, and to estimate the nitrate which it had absorbed, and determine exactly the nitrate remaining in the sand.

Here a difficulty presented itself. To obtain sufficient accuracy, it was necessary to submit to analysis a very large quantity of sand; it was better to analyse the whole; but as the operation became almost impracticable where the mass of soil was considerable, I was obliged to restrict the quantity. And to estimate the influence which the volume of the soil rendered sterile exercised on the vegetation, I repeated the experiments which I had already performed in the open air, but I increased the quantity of sterile soil. These two experiments were made on a lupin and on a cress. I will confine myself to the results of the first experiment.

EXPERIMENT ON THE LUPIN.

	Grammes.*
Sand and pieces of quartz,	1524
Flower-pot of baked clay,	513
Sand and pot,	2037

On 10th May 1855, I planted a lupin weighing 0.302 grammes. The plant grew in the open air, but measures were taken to put it under shelter immediately on its commencing to rain. The flower-pot was placed in a porcelain dish, raised about 1 metre above the grass. There was added to the calcined sand 1.3 gr. of washed ashes, and 0.2 gr. of alkaline ashes. The watering was done with water saturated with carbonic acid gas.

* Gramme=15.4325 grains troy.

We finished the experiment on the 2d of August, when the cotyledons were withered, and some of the inferior leaves discoloured. The plant was 0.12 metres in height; it bore 14 leaves; when dried it weighed 1.415 gr.; that is to say, five times as much as the seed. The result of the analysis is as follows:—

	Grammes.
In the dried plant, nitrogen,	0.0166
The tenth part of the soil was found to contain of nitrogen 0.00039 gr., therefore the whole contained,	0.0039
	0.0205
The grain contained of nitrogen,	0.0170
Gain of nitrogen in three months of vegetation,	0.0035

It is very nearly the same result as that obtained last year from causing a plant to vegetate in a soil whose mass was ten times less.

In this experiment, performed in the open air, fully exposed to the sun, with a wind sometimes pretty strong, it consumed by watering a very considerable quantity of water. But as neither this water nor the ashes added to the calcined sand contained appreciable traces of ammonia, it was not necessary to introduce corrections; the result has been obtained directly from the numbers given in the analysis. This is often, in my opinion, an essential condition; for an experiment of this nature is evidently injured, when, on account of the impurity of the agents which have been used for the growth of the plants, we are obliged to have recourse to corrections.

Being assured of the influence exercised by the mass of a sterile soil on vegetation, I kept up the weight of the sand in which the plant was to grow between the limits which permit of an analysis being made in operating on the third or half, so as to multiply the errors inherent in the process as little as possible. The weight of the soil was from 200 to 300 grammes.

First Experiment.—Influence of the Nitrate of Potash on the growth of the Sunflower.

Two seeds of the sunflower, weighing together 0.062 gr., were deposited on 10th May 1855, in calcined sand, with which had been mixed 0.1 gr. of alkaline ashes, and 1.0 gr. of washed ashes, and successively, in the course of the experiment, 1.11 gr. of the nitrate of potash. The sand was moistened at the commencement with pure water, and, after germination, with water saturated with carbonic acid. The plant grew in the open air, under a glass roof, which sheltered it from the rain and the dew. This precaution was taken in all the experiments detailed in this memoir.

By the 20th May the seeds had brairded; after that the plants made rapid progress. On the 19th August one of the plants attained the height of 0.72 metres, and carried nine fine leaves and

one floral bud; six faded leaves adhered to the inferior part of the stem. The other sunflower was 0.50 metres in height, and had six leaves of a beautiful green, and seven faded ones. On the 22d August the top of the stem of one of the plants being broken, the experiment was brought to a close.

The two plants, after being dried, weighed 6.685 grammes, viz.:—

	Grammes.
Stem,	3.990
Leaves,	1.635
Roots,	1.060
	6.685

From which were obtained 0.1126 gr. of nitrogen; and from the sand and flower-pot, which together weighed 242.80 gr., were got 1.452 gr. of nitrogen; while the two seeds planted on 10th May, and weighing 0.062 gr., contained 0.0019 gr. of nitrogen.

In comparing the quantity of nitrogen introduced with the nitrate of potash with that we find in the plant and soil, we get the following results:—

	Grammes.	Grammes.
Nitrogen in the dry plant,	0.1126	
Do. in the soil,	0.0452	
		0.1578
Nitrogen in 1.110 gr. of nitre,	0.1536	
Do. in 0.062 gr. of seed,	0.0019	
		0.1555
Gain of nitrogen in plant and soil after four months' vegetation,		0.0023

If the plant obtained from the nitrate all the nitrogen contained in its albumen and its casein, it should have absorbed of it 0.8026 gr. Now, as every equivalent of nitrate which enters into the composition of a vegetable, carries with it one equivalent of alkali, it follows that the sunflower, in assimilating 0.1126 gr. of nitrogen, received 0.3741 gr. of potash. On examination of the ashes, we calculate that the 6.685 gr. of the dried plant contained 0.419 gr. of alkali, that is 0.05 gr. more than the quantity calculated on from the nitrate absorbed; but we attribute this excess to the alkali which was furnished by the vegetable ashes added to the soil at the commencement of the experiment.

We have seen that from the nitrogen obtained during vegetation, there would have been absorbed 0.8026 gr. of nitrate. As there were 1.110 gr. of nitrate used, there ought to remain in the soil 0.3075 gr. A special investigation showed that the sand contained 0.34 gr. of saline matter very rich in the nitrate of potash. From the foregoing facts, we are entitled to draw the following conclusions:—

1. The nitrogen of the nitrate absorbed is assimilated by the plant. 2. For every equivalent of nitrogen assimilated, the sun-

flower receives into its composition one equivalent of potash. 3. We find in the soil nearly the whole of the nitrate which the plant does not absorb. 4. The action of the nitrate of potash, which is most decided from the very commencement of vegetation, manifests itself without the necessary addition of any putrefying organic matter.

What takes place when the nitrate has entered the plant? Is its nitrogen, before entering into the constitution of vegetable albumen, transformed into ammonia, according to the reaction indicated by M. Kuhlman? This is a question which my experiments cannot solve.

Second Experiment.—Vegetation of the Sunflower in a sterile Soil, without the Intervention of the Nitrate of Potash.

In order to judge better of the effects of nitre, I performed another experiment, which consisted in placing on 10th May two seeds of the sunflower exactly in the conditions in which the seeds of the previous experiments had been placed. The only difference was in withholding the nitrate of potash from the substances added to the calcined sand.

After the appearance of the primordial leaves, vegetation proceeded but very slowly. Thus, on the 15th June, the primordial leaves were discoloured, and each plant of the height of from 0.06 to 0.08 m. had two leaves of a pale green. At that time the sunflowers under the action of the nitrate of potash had reached a height of 0.20 m. On the 22d August, when the plant was raised, the slender stem of the tallest plant reached 0.20 m., and carried two leaves only, very slightly coloured, and three other small ones in a rudimentary state. The plants when dried weighed 0.325 gr. The analysis of the plant and the soil gave the following results:—

	Grammes.
Nitrogen in the plant,	0.0022
Do. in the soil,	0.0032
	0.0054
Do. in the seeds,	0.0021
Gain of nitrogen,	0.0033

In this experiment the nitrogen obtained by the growth of a plant in the open air for four months did not exceed 0.003 gr.

INFLUENCE OF THE NITRATE OF SODA ON VEGETATION.

Nitrate of soda being at present the only nitrate used in agriculture, I thought it proper to examine if, in its action on vegetation, it was similar to nitrate of potash. The experiments were made with the common garden cress; and for the sake of comparison, the plant was cultivated simultaneously in the open air, in the soil

of the garden and in barren sand. The seeds were planted on the 21st August 1855, and the plants taken up on the 7th October.

Third Experiment.—Vegetation of the Cress in a Soil highly manured.

Ten seeds furnished ten plants in flower, weighing, when dried, 1,580 grs.; that is to say, 66 times the weight of the seed. The nitrogen acquired in six weeks was raised to 0.053 grs.

Fourth Experiment.—Vegetation of the Cress in a sterile Soil.

To 295 grammes of sand were added 0.2 grs. of alkaline ashes, and 1 gr. of washed ashes; and in this mixture 21 seeds were planted. After germination, it was watered with water charged with carbonic acid. Twelve seeds only came up; vegetation took place in the open air, but sheltered from rain. The 12 plants, when dried, weighed 0.11 grs.; that is, 3½ times the weight of the seed.

	Grammes.
Nitrogen in the plant,	0.0016
Do. in the soil,	0.0030
	0.0046
Do. in the seeds,	0.0021
Gain of nitrogen in 7 weeks' vegetation,	0.0025

Fifth Experiment.—Vegetation of the Cress under the influence of Nitrate of Soda.

Everything being arranged exactly in the same manner as in the fourth experiment, 0.216 grs. of nitrate of soda was gradually introduced into the soil; from 16 seeds sown on the 21st August, 16 plants were raised of vigorous growth. The leaves were of a dark green; but they were somewhat less than those of the cress in the garden soil; the plant had stoled out. On the 9th October, when the experiment terminated, each plant had from 8 to 12 leaves. The plants, when dried, weighed 0.831 grs.; that is, 22 times the weight of the seeds.

	Grammes.	Grammes.
Nitrogen in the dried plants,	0.0254	
Do. in the soil,	0.0088	
		0.0342
Do. in 0.2163 of nitrate of soda,	0.0357	
Do. in 16 seeds,	0.0019	
		0.0376
		0.0034

We find thus, in the crop and in the soil, with 0.0034 grs., the nitrogen yielded by the nitrate; and in the sand we can discover the presence of the salt which the plant has not absorbed.

The apparent result from these researches is, that the alkaline nitrates act on vegetation with as much readiness, and perhaps

with more energy, than the salts of ammonia. Thus, in the experiments with the sunflower, performed with soils of the same nature, of equal volume, and in identical atmospherical conditions, in the open air, and watered with the same water, we saw that by the introduction of only 1 gramme of nitrate of potash, the plant attained a height of from 50 to 72 centimetres, carried a flower, assimilated more than 1 decigramme of nitrogen, and produced of dried matter 108 times the weight of the seed. The plant fixed about 3 grs. of carbon; that is, in 3 or 4 months it decomposed more than 5 litres* of carbonic acid gas, in order to appropriate its base. What took place when the nitre was absent? The sunflower was scarcely developed; its small stem carried 2 or 3 leaves of a pale green; only 3 milligrammes of nitrogen were assimilated; consequently, it did not contain sensibly more of azotised tissue than existed in the seed. The dried plant was only 5 times the weight of the seed; and in 3 months of a languishing vegetation, there were scarcely 4 decilitres of carbonic acid decomposed.

The results obtained with the cress were not less significant. In a sterile soil, the plant in 7 weeks, in the open air, did not gain 2 milligrammes of nitrogen. After it was dried, it weighed only 3 times as much as the seed, having assimilated at the most the carbon of 1 decilitre of carbonic acid, though it was watered with water saturated with that gas. A few centigrammes of the nitrate of soda changed the whole aspect of the experiment. The plant could then be compared with that which was grown in the well-manured soil of the garden. It assimilated 25 milligrammes of nitrogen, and weighed, when dried, 22 times as much as the seed from which it sprung. In a month and a half, the carbon gained represented 7 decilitres of carbonic acid.

The manifest influence of the nitrates on the development of plants corroborates that opinion expressed in a preceding memoir—viz. that the decomposition of carbonic acid by the leaves is in some way subordinate to the previous absorption of a manure acting after the manner of the manure of the farm: that manure may be indifferently ammonia, an organic matter in a state of decay—a nitrate, as these researches establish. It is enough that the nitrogen which it contains be assimilable; that it can, in a word, contribute to the formation of azotised vegetable tissue.

The demonstration of this fact, that the nitrates act very favourably on vegetation, by means of their absorption, directly, and without the concurrence of substances in a state of decay, explains why certain waters exercise such marked effects, though often they contain scarcely a trace of ammonia; it is, that these waters contain nitrates, which contribute, like ammonia—more even than it—to the production of vegetable tissue.

* 1 Litre=1.760773.

This remark, indeed, is of great importance, for, in the present state of agriculture, we may affirm that the least questionable origin of the fertility of the arable soil resides in the irrigated meadow. It is there that are concentrated in the grass the elements which are diffused in the air and in the water, which, after having passed through the bodies of animals, are incorporated in great part with the tilled soil. Thus, in whatever country agriculture may have made some progress, on account of a particular richness of the soil, we find that there have been always meadows more or less extended, annexed to the arable land. The only exceptions to this statement are to be found where the refuse from centres of population is easily procurable, and where the guano and nitrate of Peru occur.

We must, then, consider the source of fertilising principles as confined within very narrow limits, and very often it is not in the power of the cultivator to make them more abundant. In truth, we counsel him to increase the number of his animals to obtain more manure; but it is, in the end, to counsel him to have meadows where is developed that assimilating vegetation which gives unceasingly to the farm, without receiving anything. No doubt the animals are an indispensable intermediary agent between the meadow and the farm; but when, by aid of the more simple notions of the science of agriculture, we investigate how they contribute to the end in view, we find that they are not producers, but consumers of manure. In fact the animals do not, ought not to restore to the manure-heap all the fertilising principles which they consume as food, for they appropriate a part, and the conversion of that part into beef or mutton is the profit of the feeder.

In presence of the difficulty, we would say the impossibility, of procuring manure, which is known to exist in some places, we are led to ask if it is not possible to create it by causing nitrogen and certain salts to enter into combinations, that can be easily assimilated by plants. And if the solution of this problem, which its great importance raises to the height of a social question, is still far distant, we know that already science has revealed several phenomena, which are of such a nature as to make us not despair of success. Thus, in conditions perfectly determined, the nitrogen of the air, in combining with carbon, enters into the composition of an alkaline cyanid, which, once deposited in the soil, becomes a means of forming ammoniacal salts. The phosphate of lime, found so abundantly on the surface of the globe, is transformed into one of the most active elements of manure, when, by chemical means, we have destroyed the affinity with which its constituents are endowed.

Thus also the oxygen of the air, when it has been subjected to that mysterious transmutation, so as to become *ozone*, unites with the nitrogen with which it may be brought in contact, to

constitute, with an alkali, one of the most powerful of manures—a nitrate. An operation capable of inducing a rapid nitrifaction of the elements of the atmosphere, will evidently solve the principal part of the problem. I will add, that if, as M. Schoenbein admits, ozone is produced every time that organic matter enters into a state of decomposition, in a moist soil, sufficiently porous, it will very probably form nitre at the expense of the nitrogen of the air, in a soil to which farmyard manure has been applied.

Whatever be its origin, whether produced by the union of the elements of the air, or by the slow combustion of organic matter, the nitrate introduced by water adds incontestibly to the azotised assimilable principles conveyed with farmyard manure. It is by its means, combined with that of the ammonia of the atmosphere, we are enabled to explain how, in a rational system of cultivation, where manure is but sparingly applied, and where the soil is exhausted by a judicious choice of rotation, the nitrogen in the crops produced is generally greater than the nitrogen of the manure.

Rain, it is true, is the vehicle of ammonia from the atmosphere, but it is an error to suppose that, apart from manure, the soil receives its fertilising principles in proportion to the quantity of rain water. It is to suppose that the earth receives no other water than what falls from the clouds. Nevertheless spring waters penetrate through the soil by filtration and capillary attraction, and though they have their origin in the rain, they dissolve or carry away in their course useful matters; the most of them contain the nitrates, which have this advantage over the salts of ammonia, that they remain as agents of fertility after the water which introduced them has been evaporated.

Notwithstanding the power with which a nitrate acts, we cannot accept it as a manure, as it only contains nitrogen and an alkali; but, in associating it with the phosphate of lime, we obtain truly a compound possessing the qualities of guano, with more persistence in the nitrogen. In effect, on the one hand, guano consists essentially of an intimate mixture of the salts of ammonia and the phosphate of lime, in a state of nearly equal chemical division; on the other hand, it follows from the foregoing experiments that the alkaline nitrates act on plants as ammoniacal salts. In the country I intend trying, in field cultivation, a mixture of nitrate of soda and phosphate of lime in chemical proportions. When these experiments are finished, I will communicate the results to the Academy.

On the Source and Use of the Nitrates in Agriculture.—All chemists are agreed that the principal source of nitrogen in plants is the atmosphere. Most of them are also agreed that that nitrogen is conveyed to plants by means of the ammonia and nitric acid contained in the atmosphere; a small minority maintaining that

plants absorb directly the free nitrogen of the atmosphere. It has, however, been a disputed point as to whether plants assimilate all their nitrogen directly from ammonia, the nitric acid being converted in the soil into ammonia, or whether the nitrogen is obtained as directly from nitric acid as from ammonia. Kuhlman maintained the former, alleging that the nitric acid was converted into carbonate of ammonia when it was placed under the deoxydating influence of decomposing organic matter, which is the case in most soils. Boussingault, on the other hand, appears to have set this matter at rest by some carefully conducted experiments,* by which he distinctly shows that plants assimilate nitrogen directly from nitric acid.

Again, there is no element which enters into the composition of plants more slow in combining with other elements than nitrogen, otherwise the unlimited supply which we have of it in the atmosphere might be turned to good account. From the researches of Schoenbein, however, we learn that when "the oxygen of the air has undergone that mysterious transmutation into ozone, it unites with nitrogen more readily, forming nitric acid;" and this ozone, we learn farther, is discovered always when organic matter enters into decomposition in a moist soil well permeated by air. It is evident from these researches of Boussingault and Schoenbein, that nitric acid, or the nitrates, will henceforth hold a more important place in agriculture than they ever did; a place as important, if not more so, even than ammonia.

The affinity of the oxygen of the atmosphere for nitrogen also becomes greater when air is made to pass through porous bodies that have been rendered alkaline, as has been shown by the interesting experiments of M. Cloëz. Nor should we forget the services of M. Barral in this field of research. He has shown that the rains replenish the soil always with ammonia and nitric acid from the atmosphere. He has several times called attention to the influence of porous bodies in producing nitrates, which is also one of the valuable effects of the liming of land. He has proved by direct analysis that drainage, by rendering the soil more permeable to air, facilitates the production of nitrates; an effect produced also by the cultivation of the soil more or less deep, which renders it more porous. He has objected to the use of the sulphate of iron as a fixer of ammonia, because it changes the alkaline carbonates of the manure into sulphates, which have not the same action in aiding the production of the nitrates. Such, then, is the state of our knowledge on this important subject; and it is curious enough that, while the principal labourers in this field are foreign chemists, the agricultural facts have been mainly supplied by British farmers.

Let us, then, apply these principles to practice. We have been in the habit for some years of mixing, during summer, our summer-

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* See *ante*, page 319.

made manure with earth, which is generally composed of decayed weeds, wrack, road-scrapings, &c. Our reason for commencing the practice was simply because, having no land ready to which we could apply the manure, and our manure-pits being full, we thought it the best way of preserving the fertilising elements of the manure, the earth absorbing the ammonia and other products of the decomposition of the manure. We took advantage of carting it on to the stubbles, either in the autumn or during frost, as was most convenient. The practice was generally condemned by practical men, as entailing unnecessary labour in the mixing; all the advantages of mixing being obtained, they said, by forming a manure-heap and carting on it. We may mention, that being summer-made dung, it was generally more decomposed when taken from the dung-pit than if it had been made during winter. We always found that the fields or parts of fields to which we applied the mixture, produced larger crops than we expected, both the first year and the year after. And we have therefore continued the practice.

A little consideration would have convinced both our friends and ourselves that we were doing but what was right; that we were, in fact, carrying on the process of nitrifaction; that we were increasing the quantity of nitrogen in our manure by forcing that of the air into new combinations. When organic matter is in a state of decomposition under the free influence of the air, nitric acid is produced, and this process is called nitrifaction. It goes on naturally in the soils in warm climates, in India, Peru, Spain, &c.; and the nitre is produced so rapidly and so abundantly in some places, as to form nitre-beds, from which it is obtained for commerce. In more temperate regions, the presence of fermenting organic matter—such as ordinary farmyard dung—is necessary for the production of the nitric acid; and it is found that, when a heap has been formed of earth and dung, and after a time the whole of the nitric acid washed out from it, there is more nitrogen obtained than was found in the materials before they were mixed. The same thing takes place in the soil that has been well manured as in the heap of earth and dung. The more manure we add to our soils, the more nitrogen do we draw from the air and convert into nitric acid. Hence it is that a soil in a high state of fertility will produce comparatively a larger crop with an equal quantity of manure, than a soil that is out of condition,—the increase of crop being due as much to the hourly-formed nitric acid, as to the elements of fertility already existing in the soil.

What a lesson do farmers learn also from the scientific facts above stated, as to the mixing of their composts! Lime and earth are the most common ingredients of composts on our farms. The lime, while it facilitates the decomposition of the vegetable matter in the earth, adds some valuable salts to the heap (such as the nitrate of lime), by causing the constituents of the air and earth to unite in different proportions, forming nitric acid and am-

monia. This is the reason M. Barral gives for the good results which are obtained for several years, with but small doses of manure, from soils that have been limed. Alkaline substances also facilitate the formation of nitric acid, and might therefore be added with advantage to our compost-heaps. It is well known that common salt produces in many districts no effect at all when applied to the soil; but, strange enough, if it be formed into a compost with earth, and turned repeatedly, its effects on the crop are most marked. In some districts, salt is always used as an ingredient with lime in a compost. In those cases where it is not required in the state of chloride of sodium as food for plants, if time be allowed till it is resolved into its elements, its alkaline base becomes of immense service in aiding the production of nitric acid. What is done so slowly in the soil, is effected more rapidly in the compost-heap by the repeated turnings.

From the effects produced by allowing air to pass through porous bodies containing some alkaline substances, mentioned above, we learn one of the great advantages of deep cultivation and thorough pulverisation of the soil. The oxygen of the air becomes *ozonified*—unites more readily with the nitrogen, forming nitric acid, which combines with the alkali present, and gives us a most valuable manure—a nitrate. May not the secret cause of the great success attending deep cultivation at Yester be this? That the soil is most thoroughly comminuted, there can be no doubt. It is, though naturally a stiff soil, rendered porous to a greater depth than most soils, with nothing to obstruct the free passage of the air, and everything to act on the constituents of the air; for, by subsoiling an alkali, potash is obtained in greater abundance than it is found in the soil. In short, we may say that the different operations at Yester are equivalent to an application of the nitrate of potash. This does not in the least detract from the merits of the noble proprietor in prosecuting so vigorously deep cultivation on his farm; on the contrary, we think it redounds to his honour: for we hold that he is to be considered the best farmer who can adapt the most economical means for raising the largest crop, to the circumstances of his farm; and this the Marquess of Tweeddale has done.

We are thankful to men of science for having shown us how to advance one step towards increasing our nitrogenous manures on the farm. When obtained from extraneous sources, these manures are expensive, and may become much scarcer than they are at present; and their application in the form in which they have been purchased has not proved very profitable during the past year. We know whence we can draw an unbounded supply; we know how we can apply them most profitably when we have obtained them; and science is now trying to discover how we may obtain them most economically. Large sums are now being offered for the discovery of substitutes for guano. We are of

opinion that farmers should not look too much beyond their farms for that substitute; for we are convinced that the time is not far distant when, by the skilful application of scientific principles, they will find that substitute in the nitrogen of the air, and in bones.

Poultry Progress during the Past Year.—The everyday qualities of the *Dorkings* have kept them in steady popularity, and their progress has been uninterrupted. Beauty of feather has been combined to large size, and although they have not reached the prices made by fowls a few years since, yet they always find a market, and realise sums not only sufficient to remunerate the breeder, but to incite him to exertion in producing the best specimens. These birds have frequently made from five to seven guineas each, and one cock was recently sold for fifteen pounds. It is an indication of an improving state when a large number are sold at a good, though moderate price, rather than a few at a large rate. The most preposterous opinion ever yet formed in poultry matters, viz., that double combs were impure, has been quite set aside by the decisions at all the principal shows, and those who were sticklers for any particular plumage have gradually given up their notions.

The remarkably cold and late spring was so unfavourable to them, that the *Spanish chickens* have been late, and this has caused some to think this breed has not made much progress; but we shall be much deceived if the chickens we have seen do not vindicate their claims to progress in this year. Spanish pullets are things of time, so far as White Faces are concerned, and cannot reach perfection till a certain age. Unless increased size is attained, we do not see where the improvement is to come from in the adult birds. There is one thing worthy of remark in the cocks of this breed—formerly every bird had a drooping comb, but when it was known an upright one was preferable, breeders took pains, and a drooping comb is seldom met with even in numerous classes. Amateurs in every race may take a lesson from this.

We have been glad to mark improvement in the *Cochin-China* classes. If birds could speak, none would have more reason to complain than these, that they were petted and really spoiled during two years, subjected to all sorts of unnatural treatment to enable them to obtain a fictitious price, and then suddenly cast aside as worthless. Their really valuable properties were often destroyed by stimulant and flesh-making food, to increase their value. We have, then, rejoiced to see of late that good birds have made good prices, and that there was an approach to their palmy days in quality. We do not wish to revive the "mania;" but they are worthy fowls, and they deserve encouragement.

Hamburgs in all classes have "progressed," but the Spangled more than Pencilled. Here, again, breeders have conformed to rule, and the hen-tailed cocks have almost entirely disappeared. The Golden Pencilled have made more progress than their Silver

brethren. Many of the former reminded us of the splendid birds of four years since.

Poland fowls keep up their quality, but the Silver are superior to the Golden. It is for amateurs to discover the cause, and remedy it. The superiority is in every point—marking, top-knot, and size.

To praise the *Game* fowls would be to "paint the lily." We always have perfect birds of this beautiful breed, and they well deserve the numerous classes allotted to them in every exhibition. It always seems to us the game breeders take more pains with their fowls than any others, and the condition in which they bring them to exhibit is worthy imitation. The truth is, most of them are lovers of their fowls, while many others are only amateurs.

Differences of opinion still exist about *Brahmaputras*, but they have made classes everywhere, and show entries enough to maintain them. Their merits or demerits may be argued in our columns, and we shall be happy to give space for them.

Bantams are decidedly better than they were, and the introduction of Game fowls reduced to this size is a pleasing variety. As a consideration of bare utility will only keep a pursuit at a certain measure, we hail the improvement in these various sorts, as White, Black, and Game, with much pleasure.

Turkeys have remained stationary during the year.

Not so the *Aylesbury Ducks*. We last year noted they had attained the weight of 6½ lbs., but now we may add another pound —7½ lbs. has been a frequent weight for prize birds.

The *Rouens* have not been behind. And here, again, it may be noticed, that as soon as it was known what were the requisite points, they were immediately produced.

Geese have now been commonly brought to 17 lbs. while goslings; and from 20 to 24 lbs. when full grown.

The past year, then, has been pregnant with improvement to poultry: and the increase to the amount of food produced by well-selected and proper birds, instead of the chance ones formerly kept, invests the subject with an importance it does not at first sight possess. It may be said with truth, that the attention paid to poultry of late years has caused an addition of one-fifth to the weight of every bird; and this, spread over the whole quantity produced, would yield a result which would startle even the most sanguine.—(*Poultry Chronicle*).

Feeding Sheep on Prepared Food.—Much has been written of late years on the advantage of mixing different kinds of food for cattle and sheep, and the merit of having first adopted the practice has been attributed to several English and Scotch farmers. We do not in the least intend to detract from the merit of any of these gentlemen; but we must admit, both from our own observation and from reading, that the plan of mixing different kinds of feeding-stuffs, particularly for winter keep, has been long followed

by many farmers both in France and Germany. Indeed, the facility with which winter food could be provided in this country by the growth of turnips, tended, in a great measure, by rendering farmers independent of other resources, to retard the adoption of so useful a practice as the mixing of different kinds of food. We are glad to find that the Highland Society has this year introduced into its premium list this important subject, having offered premiums for the best reports on the feeding of cattle on whole turnips, on cut turnips, and on pulped turnips mixed with straw.

Comte de Gourcy, in one of his excursions, visited the farm of Bresle (Oise), with which was connected a sugar-manufactory. M. Hette was the manager of both the farm and the manufactory. He fattened off last year (1854) 7000 sheep. In one of the sheep-folds of this establishment, where there were 500 half-bred sheep, there were consumed every day 880 lb. of the pulp of the beetroot, 440 lb. of rape-cake, 440 lb. of poppy-cake, 385 lb. of chopped green forage, and 385 lb. of chopped straw, with 5 lb. of salt, all mixed together. The shepherd chiefly buys and sells the sheep. His wages are 800 francs, besides his food and perquisites, valued at an equivalent sum. The sheep cost from 18 to 23 francs each, the ewes from 13 to 20 francs each; the weight of the fleece varies from 6½ to 12 lb.

The sheep consume at most about 1 lb. of rape-cake, but they eat greedily 2 lb. of poppy-cake; and a mixture of the two kinds seems to answer well. When their food is given them, they commence eating the pulp of the beetroot; they pick out next the cake, and lastly they take the cut forage and straw. Besides the sheep, there are 40 swine and their pigs kept on this establishment. About 280, from eight months to one year old, are fattened off every year. They are of different English breeds. As there is great scarcity of straw, the swine are fed in sties floored with open boards, which enables M. Hette to dispense with the use of straw, and at the same time keep the animals dry.

Mangold (*Mangel-Wurtzel.*) By John Towers, of Croydon.—This root is rapidly advancing in general estimation; nor is it to be wondered at by those who witness the surprising luxuriance of the broad crops now upon the land. I am always gratified when I can refer to Mr Stephens' *Book of the Farm*, and upon the present subject shall venture to appeal to it. First and foremost, however, to correct what I presume may have been a misconception in respect to the two names which have been conferred upon the plant. The well-sounding term, Mangold, was substituted some years after its introduction here; but it would appear without good authority. At vol. ii. p. 93, par. 3397, we read—"The former phrase, mangel-wurtzel, means the root of scarcity, and is used by Thaer in common with the former (mangold) to denominate the field-beet." I was instructed some years past by a clever and travelled German scholar, that mangold had been erroneously adopted; and, con-

sulting the dictionary, I found that, in Germany, it was applied to the red beet of the *garden;* whereas the original words, mangel-wurtzel—" the root of scarcity"—really imply, a root by which scarcity is removed; and most appositely, as the root, by its vast abundance and prolificness, justifies that acceptation of the term wurtzel.

Not, however, to dwell on the mere correction of a word, and as it does not enter into the object I have in view—namely, to describe the method of culture now practised in East Surrey—it will suffice to say that there are three chief varieties of the field-beet which claim attention, namely, the long red, the short red, and the yellow or orange globe. It is to the last of these plants that the few following observations will be restricted. They all abound in nutritious vegetable elements. By recent researches, conducted by Fromberg, it would appear that the proportion of nitrogenous, protein, or flesh-forming principles of the globe in the dry state are as 14.40 to 10.70 in the long-red; while, admitting that chemical analysis, by the refined processes now adopted, tends to occasion unavoidable losses and derangement of the organic constituents, it yet appears highly probable that the globe variety ought in most cases to be preferred, compactness of form and growth being also kept in sight. On one occasion I had suggested to the late Professor Johnston the advantage that might be derived from a thorough investigation of the *juices* of a plant, and I was favoured with a letter in reply, which assured me that he approved of that more *direct* process of analysation. By reference to the *Book of the Farm*, vol. i., par. 900, we read—" The quantity of nutritive matter afforded by a crop of mangold-wurzel of 20 tons, or 45,000 lb. per acre, consists of 900 lb. of husk or woody fibre; 4950 lb. of starch, sugar, &c.; 900 lb. of gluten, &c.; and of saline matter, 450 lb. No oil or fat has yet been detected in an appreciable quantity. By this quotation from Johnston's *Lectures on Agricultural Chemistry*, we get at the truth of the matter; and learn that the starch and sugar comprise the fat-giving elements, and that the 900 lb. of gluten constitute the protein or *primary* nitrogenous principle upon which depends the support of the sanguinous and muscular systems.

The mineral elements of the bulb and leaves, as determined by analysis of their ashes, are tabulated in par. 3399, *Book of the Farm*, vol. ii. To that the reader is referred as indicative of the preponderance of alkaline and saline ingredients—namely, 52.62 per cent of potassa and soda, and 24.54 per cent of common salt in the bulbs. Before I enter upon the consideration of the subject which has induced me to trespass on the pages of the Journal, I must notice the first lines of par. 3384, wherein Mr Stephens says, " The climate of Scotland does not seem to suit mangold-wurzel." I do not venture to impugn the authority of Mr Stephens' experience in Forfar; but yet may be permitted to suggest, that a plant which did not entirely succeed in a locality $56\frac{1}{2}$ degrees north latitude, might prosper and be remunerative in the best and most

fertile southern counties of Scotland, wherein wheat-growing can compete with the more northern shires of England. Let us retrace the enduring severity of last winter, which, even in Surrey, was protracted beyond the 13th of May, when the thermometer marked 32 degrees—the mean of the day being 11.5 degrees minus; and then consider the surpassing luxuriance and bulk of the bulbs, red and yellow, which now burden the ground—and the fact may then become patent, that, with better experience, more appropriate soil, and superior tillage, results more highly satisfactory will be obtained. I do not offer any remarks upon the general culture of mangel-wurtzel, since the *Book of the Farm* comprises all that need be required upon that subject. The following lines refer to one particular line of practice, which has conclusively proved that *mangel-wurtzel* can be grown *upon the same land, year after year*, with complete success. I have had much satisfaction in being able to watch the progress of the plants upon a plot of ground adjoining the main London road near Croydon, and at an easy distance from my own residence. While I now hold the pen, there stands, *for the fourth consecutive year*, as fine a crop of the *orange-globe* variety as any cattle-feeder could desire to possess; and while attesting the interesting fact, it remains to state the operations by which it has been realised. The land forms a portion of an estate occupied by a gentleman of great wealth. The natural soil is of a strong binding character, like that of the neighbouring locality, north-west of the railway, where the London clay commences; but as the extensive property commands every appliance for the generous tillage of grass-land and garden-ground, there exists at all times an abundance of the richest stable manure, combined with much decaying vegetable matter. With this best of organic stimulants, and a thoroughly deep laboration by *the spade*, the ground has been perfectly meliorated and enriched to a great depth. The seeds are sown at the usual period of the spring, and the plants rise somewhat confusedly, in consequence of the number of seeds which exist in each husk. They are in due time singled; and now stand in rows about 18 or 20 inches asunder, and 12 inches apart in the row. The surface of the ground is kept constantly clean, and only a very few plants are seen to have run to seed. Mangel-wurtzel, like the red garden-beet, can be transplanted, but at the risk of incurring that defect. Some few of the plants are of the long-red variety, a circumstance originating in a mixture of the seeds. This is a grievance for which a dealer is highly reprehensible. Some weeks since, I observed that many of the lower leaves of a few rows had been amputated, and left upon the ground. The practice is founded in error, because every leaf is a vital organ of nutrition. True it is that the leaves may be used as cattle food, *pro tempore;* but it is bad policy to weaken the bulb, which, after all, is to become the staple food of the cattle.

AVERAGE PRICE OF THE DIFFERENT KINDS OF GRAIN,

PER IMPERIAL QUARTER, SOLD AT THE FOLLOWING PLACES.

LONDON.

Date.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 1.	85 6	45 4	29 6	54 0	54 2	50 11
8.	84 4	43 8	30 0	56 5	56 7	50 2
15.	83 4	43 7	25 8	57 2	54 11	49 8
22.	82 4	41 5	27 8	55 4	54 1	49 9
29.	82 5	40 11	25 3	54 10	50 2	46 1
1856.						
Jan. 5.	80 0	42 0	27 3	55 2	51 0	45 11
12.	78 6	38 3	25 9	55 0	49 6	45 2
19.	79 5	39 5	27 11	48 0	48 7	43 10
26.	78 4	39 4	26 6	52 0	45 1	41 1

EDINBURGH.

Date.	Wheat.	Barley.	Oats.	Pease.	Beans.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 5.	78 8	43 1	31 7	47 8	48 2
12.	76 9	42 2	30 2	48 10	49 9
19.	77 1	41 1	30 2	47 6	48 2
26.	76 10	40 8	29 5	45 6	46 1
1856.					
Jan. 2.	74 11	39 0	28 10	44 4	45 1
9.	77 9	38 10	28 4	45 6	46 5
16.	78 4	38 10	29 5	45 1	45 7
23.	70 4	35 9	26 5	42 6	43 1
30.	71 7	36 1	27 2	42 8	43 3

LIVERPOOL.

Date.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 1.	77 11	40 3	29 11	50 6	55 0	53 2
8.	77 3	41 6	29 0	52 4	54 7	52 10
15.	75 10	40 6	29 1	54 2	51 9	53 5
22.	75 2	38 6	27 6	53 6	53 1	52 3
29.	75 6	39 3	27 7	53 1	54 2	52 5
1856.						
Jan. 5.	73 8	38 5	26 6	52 8	52 4	48 2
12.	74 0	36 4	27 4	50 10	50 9	45 3
19.	77 9	40 8	29 5	46 6	50 10	48 10
26.	74 1	38 4	32 0	40 5	50 0	46 10

DUBLIN.

Date.	Wheat, p. barl. 20 st.	Barley, p. barl. 16 st.	Bere, p. barl. 17 st.	Oats, p. barl. 14 st.	Flour, p. barl. 9 st.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 7.	46 2	24 4	21 6	16 7	27 6
14.	43 10	23 2	20 4	16 8	27 8
21.	43 5	23 8	20 1	16 7	27 4
28.	43 2	22 6	19 6	16 2	27 2
1856.					
Jan. 4.	43 1	21 10	18 6	15 5	27 0
11.	43 6	21 11	18 10	15 7	26 10
18.	42 6	21 0	17 9	15 0	26 8
25.	40 4	20 7	17 6	14 11	26 6
Feb. 1.	39 8	19 10	16 8	14 8	26 4

TABLE SHOWING THE WEEKLY AVERAGE PRICE OF GRAIN,

Made up in terms of 7th and 8th Geo. IV., c. 58, and 9th and 10th Vict., c. 22. On and after 1st February 1849, the Duty payable on FOREIGN CORN imported is 1s. per quarter, and on Flour or Meal 4½d. for every cwt.

Date.	Wheat.		Barley.		Oats.		Rye.		Pease.		Beans.	
	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.
1855.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 1.	83 1	80 10	42 3	40 0	28 10	28 4	53 0	52 5	52 5	51 3	53 3	51 10
8.	83 1	81 4	42 5	40 8	28 6	28 4	53 9	52 7	51 5	50 9	52 3	52 0
15.	79 11	81 4	41 3	41 0	27 10	28 3	55 4	53 3	49 1	51 1	51 8	52 2
22.	78 9	81 0	40 4	41 2	27 1	28 1	54 6	53 8	48 11	50 8	50 8	51 11
29.	77 2	80 5	39 4	41 1	26 11	27 11	51 11	54 1	47 6	50 3	49 0	51 5
1856.												
Jan. 5.	76 10	79 6	39 0	40 9	26 9	27 8	52 7	54 0	47 3	49 4	47 7	50 9
12.	76 2	78 5	38 3	40 1	25 11	27 3	53 6	54 1	45 7	48 2	46 5	49 7
19.	76 1	77 6	37 8	39 4	26 7	26 10	53 4	54 0	44 9	47 2	46 0	48 7
26.	76 11	77 0	38 4	38 10	25 8	26 6	54 8	53 11	43 4	46 3	45 3	47 6

FOREIGN MARKETS.—Per Imperial Quarter, free on board.

Date.	Markets.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
		s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
1855. Dec. ..	Danzig	76 6 - 83 6	28 6 - 36 0	22 6 - 30 0	46 6 - 54 0	42 6 - 52 0	42 0 - 50 0
1856. Jan. ..	Danzig	72 6 - 80 0	25 6 - 30 6	20 0 - 26 6	44 6 - 52 0	40 6 - 51 6	40 0 - 48 6
1855. Dec. ..	Hamburg	75 6 - 84 0	30 6 - 39 0	19 6 - 25 6	43 6 - 52 6	46 6 - 57 0	43 6 - 52 0
1856. Jan. ..	Hamburg	67 6 - 76 6	27 6 - 35 0	18 6 - 24 6	40 6 - 50 0	44 6 - 54 0	40 6 - 48 0
1855. Dec. ..	Bremen	74 6 - 82 0	32 6 - 38 0	20 0 - 28 6	42 6 - 50 6	45 6 - 54 0	42 0 - 51 6
1856. Jan. ..	Bremen	68 6 - 76 6	27 6 - 36 0	18 6 - 26 0	40 0 - 48 6	40 6 - 50 0	36 0 - 45 0
1855. Dec. ..	Königsberg	76 6 - 84 0	32 6 - 39 0	22 0 - 30 0	44 6 - 53 0	44 0 - 52 0	41 6 - 50 0
1856. Jan. ..	Königsberg	66 6 - 74 0	28 6 - 35 6	18 0 - 27 6	40 6 - 47 6	40 0 - 48 0	37 6 - 46 0

Freights from the Baltic, from 4s. 3d. to 7s.; from the Mediterranean, 7s. 6d. to 14s. 6d.; and by steamer from Hamburg, 4s. 6d. to 7s. per imperial qr.

THE REVENUE.—From 31st Dec. 1854 to 31st Dec. 1855.

	Quarters ending Dec. 31.		Increase.	Decrease.	Years ending Dec. 31.		Increase.	Decrease.
	1854.	1855.			1854.	1855.		
	£	£	£	£	£	£	£	£
Customs	5,689,967	5,384,461	..	315,506	20,682,429	21,291,712	609,283	..
Excise	4,391,582	4,444,726	53,144	..	15,901,764	16,763,535	861,771	..
Stamps	1,786,769	1,695,369	..	91,400	6,988,787	6,993,148	4,361	..
Taxes	1,270,408	1,323,114	52,706	..	3,028,384	2,967,742	..	60,642
Post-Office ..	277,234	293,272	16,038	..	1,307,324	1,174,219	..	133,015
Miscellaneous	258,177	430,317	172,140	..	1,049,411	1,383,523	334,112	..
Property Tax	826,580	1,260,942	434,353	..	7,366,588	13,884,114	6,517,526	..
Total Income	14,510,717	14,832,201	728,381	406,906	56,324,687	64,457,993	8,327,053	193,657
	Deduct decrease....		406,906		Deduct decrease....		193,657	
	Increase on the qr...		321,475		Increase on the year		8,133,396	

PRICES OF BUTCHER-MEAT.—Per Stone of 14 Pounds.

Date.	LONDON.		LIVERPOOL.		NEWCASTLE.		EDINBURGH.		GLASGOW.	
	Beef.	Mutton.	Beef.	Mutton.	Beef.	Mutton.	Beef.	Mutton.	Beef.	Mutton.
1855.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Dec. ..	6 6 - 9 0	6 0 - 8 9	6 6 - 8 6	6 3 - 8 3	7 0 - 8 6	5 10 - 7 10	6 6 - 8 9	6 6 - 8 6	7 6 - 8 9	7 6 - 9 3
1856. Jan. ..	5 6 - 7 9	5 9 - 8 3	5 10 - 8 0	6 0 - 8 0	6 3 - 8 0	6 6 - 8 3	6 0 - 8 0	6 0 - 7 9	6 6 - 8 3	6 6 - 8 6

PRICES OF ENGLISH AND SCOTCH WOOL.—Per Stone of 14 Pounds.

ENGLISH.	s. d. s. d.	SCOTCH.	s. d. s. d.
Merino, ...	15 6 to 24 0	Leicester Hogg, ...	16 6 to 20 6
.. in grease, ...	12 0 to 16 6	.. Ewe and Hogg, ...	14 0 to 18 6
South-Down, ...	18 6 to 20 0	Cheviot, white, ...	14 0 to 15 9
Half-Bred, ...	13 6 to 16 0	.. laid, washed, ...	10 6 to 12 6
Leicester Hogg, ...	16 6 to 20 0	.. .. unwashed,........	8 6 to 10 0
.. Ewe and Hogg, ...	14 0 to 18 0	Moor, white, ...	7 6 to 8 3
Locks, ...	7 6 to 9 6	.. laid, washed,............	5 6 to 6 6
Moor, ...	5 6 to 7 3	.. .. unwashed,..........	4 9 to 5 9

AGRICULTURAL METEOROLOGY AND PHYSIOLOGY.

By R. RUSSELL, Kilwhiss.

"FREQUENTLY the vulgar laugh," says M. Barral,* alluding to an animated meeting of the Academy of Sciences, "at seeing the ardour with which savants discuss certain questions, nor can they comprehend the passion with which some try to find out how nitrogen enters into plants, and is fixed in them." This has been a most fertile subject for discussion ever since chemists detected this substance in plants, and became acquainted with some of its properties.

It is now generally believed that plants can only fix or assimilate nitrogen when it is taken into their organisms in the forms of nitric acid and ammonia. Liebig's memorable discovery that ammonia, or nitric acid, is contained in the atmosphere in sufficient quantities for maintaining the growth of all the plants that flourish on the earth's surface, has practically circumscribed the bounds of the discussion within the narrow limits of the capabilities which different plants have for drawing upon this inexhaustible supply.

The Rothamsted experiments, for example, seem to indicate that the wheat plant was peculiarly dependent on a supply of ammonia in the soil, but turnips were not so much so. But no sooner had many parties given their assent to these propositions, than some curious results were forced upon their notice. The Lois Weedon experiments seemed to lead to diametrically opposite results; for while wheat appeared to be in a great measure independent of an artificial application of ammonia, turnips seemed to be peculiarly dependent.

Some attempts have been made to effect a reconciliation between the results at Lois Weedon and Rothamsted; but it appears to me that no explanation of the acknowledged facts has yet been offered of a satisfactory character. Indeed, the confusion has only become more complete. An escape from this state of things, I am persuaded, can only be effected by directing our search into totally different channels which have not been explored, though they are open to all, and by no means intricate.

Before this subject can be approached, however, it is necessary to clear away the prejudices which find shelter behind what are termed "two axioms." In the last Number of the *Journal of the Royal Agricultural Society*, the editor, who dates from Kirby Hall, in commenting on the Lawes and Liebig controversy, says, "The scientific creed of the British farmer of the present day

* *Journal d'Agriculture Pratique*, 20th Nov. 1855.

might almost be said to begin and end with two *axioms*—that *nitrogen* is the principal desideratum in a manure for *corn*, and *phosphorus* in one for *turnips*." To treat these as axioms is certainly a very easy way of disposing of the subject. An axiom is said to be not demonstrable, but self-evident and admitted by all. These propositions, I admit, so far resemble axioms in the fact of not being demonstrable.

But even viewing the matter in its practical aspects, as it has been done in this instance, to put forth the moiety of truth contained in these propositions or recipes in such a form, is doing more to retard the progress of agricultural science than anything that I know. It is both an injustice to Lawes and to Liebig. But, on the other hand, if Liebig's reviewers had been successful in giving reasons for the grounds of such an extraordinary summary of experimental research, there would not have been one word of controversy on the subject. Liebig's reply is chiefly directed towards demonstrating the fallacy of these famous propositions, but he cannot understand what may be regarded as the mere provincialisms of the subject, which are mistaken for leading principles in the theory of vegetable nutrition. In discussing this subject I shall first demonstrate the fallacy of supposing that "*ammonia* is peculiarly fitted for *grain*, and *phosphorus* for *turnips*," and afterwards show that, on the ground upon which this subject has been argued by Liebig's reviewers, the action of manures and the theory of rotations can only be elucidated by investigating those branches of agricultural science that form the subject of this paper.

But, first of all, what are the reasons which have been assigned for phosphates being peculiarly fitted for turnips and nitrogen for corn? No longer ago than 16th May 1855, Professor Way, in a lecture delivered before the Royal Agricultural Society, attempts to trace an analogy between the feeding of plants and animals:—

"Something of the kind had certainly been found to be the case in the artificial feeding of plants, in which, greatly through Mr Lawes' experiments, we have found that the *wheat crop*, by *no means* the most rich in *nitrogen*, benefited more than most others by manures containing this *element*, and was not sensibly affected by *phosphoric manures*, although eminently a *phosphate-containing plant;* whilst *turnips*, on the other hand, *not* containing any great quantity of *phosphates*, are successfully cultivated by this *artificial addition*."

Professor Anderson also gives a summary of Mr Lawes' views on the action of manures and on the theory of rotation of crops, in the July Number (1854) of the *Transactions of the Highland and Agricultural Society*, as follows:—

Mr Lawes, founding on certain experiments which show that plants exhale nitrogen, believes that the nitrogen which has disappeared has actually

undergone this process. In doing so (if I do not misunderstand his view), it acts, so to speak, as a carrier of carbon—that is to say, the quantity which passes through the plant stands in a direct relation to the quantity of carbon assimilated, and converted into non-nitrogenous compounds, such as starch, &c. Hence the cereals, which contain in their seeds a large quantity of such compounds, require the passage through their system of abundance of nitrogen, and consequently exhaust the soil. On the other hand, the bean, and leguminous plants generally, which yield a seed containing a trifling proportion of carbonaceous compounds, though rich in nitrogen, do not exhaust the soil, because they take only enough of that element to produce their nitrogenous compounds, and do not require that much larger quantity, which in other plants is not retained in their system, but is expended merely as a means of causing the accumulation of a sufficient quantity of starch, &c. in their seeds. Founding upon this view, he points out that the turnip, which, when grown for its bulb, does not exhaust the soil because it does not require nitrogen, becomes a scourging crop when grown for seed, which contains a large quantity of oil, and hence requires the expenditure of that element. Ingenious as this view is, I fear it can scarcely be considered as *altogether* satisfactory.

What do the Rothamsted experiments prove?. The results are really interesting and curious. The Rothamsted soils produce from 16 to 17 bushels of wheat, year after year, without manure of any kind; but the same soils only produce a few cwt. of turnips, year after year, when no manure is added. The addition of *superphosphate of lime,* however, raises the produce of turnips to about 8 tons an acre year after year, when they are supplied with this substance. On the other hand, superphosphate of lime does not raise the produce of wheat above the 16 or 17 bushels that grow without anything. This is the foundation for the axiom, "phosphorus for turnips," and there is nothing more in it.

But let my readers only bear two things in mind, and all others will become pretty plain: first, that 16 to 17 bushels of wheat can only be regarded as about *a third part of a full crop;* second, that 8 tons of turnips can only be regarded as *a third part of a full crop.* Neither of these crops can be raised above a *third,* however much superphosphate may be added. When full crops are spoken of, or meant, it would be, therefore, just as proper to say *nothing* for wheat, as to say *phosphorus* for turnips.

What do the Lois Weedon experiments prove, that have been regarded as the "Eden of mystery?" Mr Smith raises double the quantity of wheat on an acre, year after year, that Mr Lawes does, for the average produce of the Lois Weedon soil is about 34 bushels, or about *two-thirds of a full crop,* without manure of any kind. The axiom "*nitrogen* for corn" makes these results very perplexing. Mr Smith's crops of turnips may be regarded as full ones, but he does not act upon the recipe, "Phosphorus for turnips." True, he adds a cwt. to his crop out of deference to the "axiom." He manures his land heavily, before winter, from the

farmyard, and adds guano in spring, and obtains full crops, exceeding 20 tons to the acre. His recipe, therefore, is *nitrogen* and *phosphates* for turnips, and *nothing* for wheat. Mr Lawes has been very unfortunate in his application of nitrogenous manures to his turnips; for with a full supply of superphosphate of lime, 10 cwt. of rape-cake, and 3 cwt. of sulphate of ammonia to the acre, he did not raise the produce of bulbs above the quantity obtained by superphosphate alone. For this reason nitrogenous manures have got a very bad character at Rothamsted, as an application to turnips, but a good one at Lois Weedon. A glance at the different systems pursued at Lois Weedon and Rothamsted will not be taken without teaching some useful lessons.

Mr Smith, at Lois Weedon, dresses his turnips heavily with nitrogenous manures, and sows them in 5-feet rows, and afterwards singles them out 9 inches apart. This is scarcely 2½ plants to the square yard. But Mr Lawes sows them in narrow drills, and, even when he dresses heavily with the richest manures, he allows 8 plants to the square yard. To sow so thickly, and to dress so heavily, are the chief reasons of nitrogenous manures being *theoretically*, but not *practically*, unpopular as a dressing for turnips in England. Those who condemn nitrogenous manures for turnips should take a leaf out of Mr Smith's book. This is the plain and practical statement of the subject; the theoretical will come on by-and-by.

In regard to the wheat crop, a reconciliation has been attempted between Rothamsted and Lois Weedon. It is held that wheat cannot abstract any of its ammonia directly from the atmosphere. To account, then, for the extraordinary results from mere tillage at Lois Weedon, the soil is supposed, *first*, to absorb the ammonia from the air, and *then* to supply it to the roots of plants. This, I consider, is a simple but erroneous way of explaining the large crops got at Lois Weedon without manure. I have not yet got hold of any evidence that the chemical absorption of ammonia from the atmosphere by soils throws any light on the principles of vegetable nutrition. I shall endeavour to show, with as much clearness as I possibly can, that there is the highest probability for believing that the large crops of wheat obtained at Lois Weedon without manure, are chiefly due to the economising of the natural supply of ammonia derived directly from the soil, and also that, through the system of cultivation which is pursued, the wheat plant *is placed in conditions favourable to its absorbing an additional quantity of ammonia directly from the atmosphere.*

For the sake of brevity, I shall not enter, at this part of the subject, into the systems of cultivation pursued at Lois Weedon and Rothamsted. But Mr Smith of Lois Weedon will excuse me, I hope, though I find it necessary at the outset to point out that he entirely misinterprets Tull's theory of vegetable

nutrition.* Of all the theories of the nutrition of plants that were ever proposed, Tull's was the most simple. This any one will see who reads his essay on "Horse Hoeing." He, in fact, ridiculed the idea of the food of plants consisting of "nitre," or of "water," of "fire," or of "air." According to him, the food of plants was "earth," which only required to be sufficiently divided by cultivation to enable it to pass into the vessels of plants, and to be digested into their substance. In fact, Tull's theory of vegetable nutrition would answer to Herr Wolff's pure mineral theory.

Much do the modern commentators of Jethro Tull err who imagine that the chief benefit of stirring soils depends upon soils containing substances which have a *chemical* affinity for the ammonia floating in the atmosphere. Tull very justly observes that "*hoeing keeps plants moist in dry weather*," in consequence of a stirred soil absorbing moisture more readily from the atmosphere. This applies to all soils, and far more so, in ordinary circumstances, to sandy loams than to clays. Thorough disintegration imparts a greater absorbing power to all soils. It is highly probable that land absorbs ammonia from the air when it absorbs moisture. But this power does not depend upon the *chemical* properties of soils, but upon their *hygroscopic* properties. Tillage thus so far compensates for a larger fall of rain, and tends to maintain plants in healthy conditions, so that they can work up with economy the materials which they find in the soil and atmosphere.

Cobbett brings out this view as the prime practical doctrine taught by Tull, who throughout his Essay illustrates this part of the subject, and the economy of thin sowing, with great ingenuity and beauty. But Cobbett always urged what Professor Anderson has done from other considerations, that stirring the soil and admitting the air serve to waste the organic matter it contains in the same way that turning a dung-heap promotes fermentation. However, the followers of Jethro Tull, who really believed in his doctrines of vegetable nutrition, may be likened to the sons of the father in the fable, who, to stimulate their industry, told them the story of the treasures hid in the ground. So Jethro's disciples, in searching after the treasures of a perfectly-tilled soil, had also their reward, as it enabled them to make the most of all soils, be they rich or poor.

But, for my part, I cannot point to a single passage in the writings of Tull in which he takes a comprehensive view of the difference between the vegetation of nature and of art. Indeed, with the exception of one single sentence, which I shall afterwards

* *Lois Weedon Husbandry*, p. 106.

quote, he, even for his own day, had altogether an exaggerated idea of the effects of tillage in promoting the growth of plants. In his attempt to silence his two philosophical opponents—Bradley and Van Helmont—who were already on the track leading to the discovery that "water" and "air" were the chief substances upon which plants fed, what was his argument?—

"*If water or air was the food of plants, I cannot see what necessity there should be of dung or tillage.*"

This is still the whole question at issue. May not the author of the "Word in Season," in adopting Lawes' and Boussingault's views that the wheat plant and all cereals and grasses cannot absorb any ammonia directly from the atmosphere, be held as practically asking Liebig a somewhat parallel question—"If ammonia is not supplied to the roots of the wheat plant by my system of cultivation, what is the use of my digging and hoeing?" So it is my object, though I thus differ from Mr Smith on some nice points of theory, to attempt an answer. I have read his book with much pleasure, and I could not give him a single hint how he could improve his practice.

In subtile points let eager critics fight,
Surely he's not far wrong whose practice' right.

My readers have already seen that while the Rothamsted soils produced a third of a crop, or 16 bushels of wheat, year after year, they could only produce a *third of a crop*, or 8 tons of turnips, if they were supplied with phosphates. These soils also are made to produce heavy crops of wheat by the mere addition of ammonia. This fact implies that the wheat plant can obtain all the earthy substances which it requires, but the turnips must have phosphates. But Mr Lawes has inferred that if phosphates are supplied to the turnip, it will obtain all the alkalies which it requires. This may perhaps be true of his own soil, but it is not so of others.* Still,

* It is almost useless to say that many soils are very deficient in alkalies. On the farm which I occupy, there are nearly 100 acres upon which 10 tons of turnips will not be got to the acre after the land has been pastured for several years, and only one corn crop taken, though as many cwt. of superphosphate or guano were applied. The same soils will not be made to grow more than two crops of corn with pure nitrogenous manures. But to limit the grounds of discussion, I have supposed that the soil contains abundance of the earthy substances required by plants. Unless we make such limitation, no progress is made. As an illustration how little physiologists have done for throwing light on the theory of rotations, I extract the following from Mohl's work on "Vegetable Cell:"—"A large portion of the parasites agree with common plants fully in their habits, colour, &c.; another portion consists, on the contrary, of leafless plants not of a green colour, which bear the same relation to the plants which feed them as the flowers and fruits of other plants do to their vegetative organs. In the second place, there exists a large number of plants which in part resemble parasites in their exterior, and in the want of the green colour, in part possess the usual aspect, and which derive their nourishment only from vegetable or animal substances in a state of decomposition. To these belong, besides the numerous class of Fungi, Orchidæ, bog-plants, &c. Thirdly, the *majority* of other plants

to simplify this discussion, I shall take for granted what he wishes to establish, that if ammonia is added to soils, wheat will obtain all the earthy substances that it requires; and that if phosphorus (and I may add nitrogen) is supplied for a crop of turnips, it will also obtain abundance of the alkalies.

I shall suppose, then, that all soils are equally rich in those substances that are found in the ashes of plants (with the exception of phosphates), and that all that is required for crops is nitrogen and phosphates. The whole discussion, then, centres itself in the questions—

1st, Why should ammonia be required for crops, since the atmosphere contains it in inexhaustible quantities?

2d, Why should turnips require phosphates when the soil contains abundance for wheat, while wheat actually requires more phosphates for its growth than turnips?

The whole discussion, then, turns upon the mere *facilities* which plants have of obtaining phosphates from the soil and ammonia from the atmosphere. But let us reach the theoretical fallacy of the dictum or recipe, "phosphorus for turnips and ammonia for wheat," by the direct practical route. We shall make three stages of this journey, by dividing soils into three classes—1st, Those in which phosphates are very deficient; 2d, Those which contain phosphates in middling quantities; 3d, Those which have phosphates in great abundance. The ammonia question shall be treated by the way, as it is common to all.

First, then, in regard to those soils in which phosphates are very deficient: all will admit that phosphoric manures will be attended with equally beneficial effects to wheat and to beans, to turnips and to grass. Thirty years ago, the great majority of the soils in Cheshire were in this condition, and all crops were amazingly increased by the application of phosphates in the form of crushed or calcined bones. Grass was increased more than any other crop. Before the introduction of bones as a manure into

exhibit a stunted growth when raised in a soil totally deprived of organic substances. In this respect, however, as the experience of agriculturists and foresters has proved, different plants manifest extraordinarily different necessities. *While one plant, such as the fir, buckwheat, Spergula, Sarothamus, Erica, &c. flourish in a soil which contains only traces of organic substances, others, like the cereals, require for their vigorous growth a more or less abundant admixture of mouldering substances with the earth.*"—(P. 79.) Now, there are no separation of principles here—we shall never find one principle to explain the theory of rotations. More than a dozen leading principles would be required. But here we have the effects due to the meteorological conditions, the physiological peculiarities of plants, the chemical and physical conditions of soils, all mixed up. Our theoretical difficulties are like a bundle of rods, which can only be broken by untying the knot, and breaking them one by one. The most difficult subject connected with the theory of rotations is to separate the effects due to the physical and to the chemical conditions of soils. After seeing the distribution of the different kinds of trees in the American continent, I fully agree with Dr Lindley that the physical is the chief condition which determines the growth of different kinds of trees. In Scotland the chemical is more conspicuous. This is a highly interesting and extensive subject, which, like many others that come before us, is discussed on too

Scotland, the silurian soils, and the most of the old red sandstone soils, were in a similar destitute condition. My own farm was so to an extraordinary degree. "Phosphates for corn" has by no means been a negative recipe for me. Had all the soils in Britain been in the condition of those above mentioned, what would have become of the recipe "nitrogen for corn?"

Those soils that contain phosphates in middling quantities will occupy much discussion, because the Rothamsted soils belong to this class. It is upon these that what Mr Hoskyns calls the "battle of theory" must be fought. I shall, therefore, first pass on to those soils that contain phosphates in great abundance; and they shall be soon disposed of, as on this point all parties are at one. The soils in the vicinity of all our large towns contain abundance of phosphates. Dr Anderson has shown that some soils in the neighbourhood of Edinburgh contain a large per-centage of phosphoric acid. In such circumstances it is scarcely to be expected that our M'Dougals of Granton or Dicksons of Saughton will pay much heed to the recipe "phosphates for turnips." The greensands in England and the Suffolk clays are rich in phosphates, and on such soils bones are of comparatively little value for turnips. One of the witnesses examined before the "Committee of Agricultural Customs" stated, that, on the Helmingham property in Suffolk, bones were of as little value for turnips as for grass. Had all the soils of Britain been of the same character, would the principles laid down by Liebig have been less true? but what would have become of the recipe "phosphorus for turnips?"

But the recipe is still more misleading when applied to soils which contain phosphates in middling quantities, for the application of phosphates to such has led to the most erroneous ideas respecting the action of phosphates.

We have already seen that while 16 to 17 bushels of wheat can be raised year after year at Rothamsted without ammonia or phosphates, only a few cwts. of turnips could be got unless phosphates were added. These results show that wheat can produce this amount without phosphates, but turnips cannot do so; and why cannot they do so, since the wheat plant actually requires rather more phosphates than the turnip to produce that amount of grain? Because turnips have less *facilities* of abstracting the quantity of phosphates that are necessary for their growth.

This view of the question will be very evident, if we reflect for a moment on the different natures of the two plants, and the circumstances in which they are placed. The comparatively large seeds of the wheat are sown in autumn, and the plants grow little for six or seven months. During this time there is no great

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narrow a basis. Finger-and-toe in turnips, sickness in clover plants, and the dying-out of good grasses on our moory soils, on the other hand, are all referable to the chemical condition of soils.

demand for phosphates; and when the growing weather returns in spring, the roots of the wheat, being in full possession of the soil, are able to thrive in a soil where the supply of these necessary substances is somewhat scanty. Grass will also be less dependent on phosphates than wheat, simply because the vast number of rootlets in possession of the soil can very readily extract phosphates from soils, in which they exist in comparatively small quantities.

With a turnip it is very different—its seeds are very small, and its growth is very rapid. The minute seed of the turnip cannot supply the young rootlets which it sends into the ground with much nourishment; it is thus early thrown upon the soil for a supply of matter to grow its roots as well as its leaves. For it must be borne in mind that no cells, either in the roots or the leaves, can be formed without phosphates. Seeing, then, that the turnip must obtain a ready supply of phosphates before it can grow at all, need we wonder that there should be some truth in the recipe, "Phosphorus for turnips?" But could any one suppose that, although acorns were identical in composition with turnips, the oak would require more phosphates? or if the acorns were identical in composition with the grain of wheat, that the monarch of the wood, on that account, would require more nitrogen? The facilities of plants obtaining phosphates have been mistaken, somehow or other, for plants having absolutely different necessities for phosphates, due to differences in the composition of their proximate principles. It was upon these principles that Mr Lawes founded his theory of rotations,* as formerly explained in the extracts given of the exposition of Rothamsted experiments by Professors Way and Anderson.

In the same volume, however, in which the perplexing and misleading axioms—"Nitrogen for corn, phosphorus for turnips"—are once more reiterated to the confusion of science and practice, a foot-note appears, which I regard as the herald of a brighter day for science. The following is the foot-note, which ought to have been honoured with a more prominent place in Professor Way's paper on the "Value of Artificial Manures:"—

"The more recent experiments of these gentlemen (Mr Lawes and Dr Gilbert) on barley and oats, induce them to believe that soluble phosphate of lime has, in some cases, a beneficial action on these crops."

It is certainly rather too bad to introduce this heretical doctrine

* "Let it once be recognised in agricultural science that there is a definite expenditure or consumption of the nitrogenous bodies derived through the roots, connected with the fixation and elaboration of certain constituents of plants, and that this is greater or less according to the sources or the exact composition or state of elaboration of the products, and an important step will be gained towards a clearer perception of the principles involved in the alternation, in a course of cropping, of plants of varying products and habits of growth."—MR LAWES.

without one word of comment. I was very much surprised to find a complete clue to the "some cases" in which superphosphate of lime was beneficial to corn in another quarter altogether. Some other writings on the same subject are given to show how antiquated "the creed of the British farmer" must be who merely consults the *Journal of the Royal Agricultural Society*. Fair play is a jewel.

I think Dr Daubeny slightly reverses the principle upon which the action of superphosphate is hinged. He says, "It might require a certain vigour in the plant to extract a certain amount of phosphate and alkalies from the soil. By the application of ammoniacal manures this increased vigour may be imparted to the cereal crops, but not to the turnips." In my opinion, it is the existence of vigorous and rapidly-growing climatic conditions that *demand a ready supply of the essential element phosphorus;* for it is seen that phosphoric manures are most marked in these circumstances, inasmuch as the slow-growing and less vigorous turnip and barley crops of early spring, are not much benefited by the application of phosphoric manures, but under the more genial conditions of May and June these substances tend to put the plants in full possession of the soil, by promoting the rapid growth of roots and leaves, and they are thus enabled to turn the riches of nature to the best account. The wheat at Rothamsted grows slowly, and obtains its phosphates and alkalies as fast as it requires them. The increase of a crop by the application of phosphates is pre-eminently seen in turnips, but this is chiefly in consequence of the smallness of its seed and rapidity of its growth. Those plants which are in full possession of the soil, such as clover or grass, are not benefited by phosphates unless the soil is deficient in them.—*R. Agricultural Gazette,* January 24, 1852.

Barley, as one of the cereal (!) crops, requires ammonia or nitrogen in some form for its growth. Being sown so much *later* than wheat, it has less time to extend its roots in search of the minerals contained in the soil; and, for this reason, ammonia alone is a less effective manure for barley than wheat. For the same reason, barley sown in April requires more minerals than barley sown in February. I have introduced superphosphate of lime as a barley manure, on account of its effect in my experiments, where barley is grown year after year upon the same field. In combination with ammonia, it not only produces very favourable results with regard to the produce, but it brings the crop very early to maturity—a point of great importance when barley is sown late in spring. I hope very shortly to make these results public; in the mean time it will be advisable that others should ascertain the merits of this combination.—MR LAWES, *Rendle's Price Current,* 1856.

The greatest increase of cereal crops that I ever obtained from the application of artificial manures was from superphosphate of lime, to barley that was sown about the middle of May, on light sandy soil. A very considerable quantity of superphosphate of lime has been applied to late-sown barley in Fife with the best results. I would ten times rather trust my late-sown barley with superphosphate of lime than I would my early-sown swedes with the same substance. I have, therefore, no reverence for the recipe, "Phosphorus for turnips, and nitrogen for corn." I shall have a few words afterwards on the ammonia question; and in the mean time I think my readers will now

perhaps concur as I do with Liebig, that "it requires all the courage derived from a want of intimate acquaintance with the subject, to assert that certainly ammonia is peculiarly fitted for grain, and phosphorus for turnips." But the recommendation that Mr Lawes has given in *Rendle's Price Current*, as to the manures sufficient for growing a full crop of barley, points to a most important principle for which I have long contended. I knew perfectly well the authors of the Rothamsted papers, who really do know a thing or two about manures, were gradually drifting towards its recognition, although the current is still setting strongly in towards the soil-absorbing theory. The recommendations which Mr Lawes has given in *Rendle's Price Current* are contained in a table. The quantity of ammonia required by the barley crop, according as it may be *late* or *early* sown, is curious. I extract his allowances for a crop of barley from the first and last columns of his table—

Barley (early sown) after a grain crop, or when the whole of the roots are taken off the land—3 *cwt. of Peruvian guano* per acre.

Barley, sown very late in spring—1 *cwt. of Peruvian Guano, and* 2 *cwt. of superphosphate of lime* per acre.*

These are the results of the "recent experiments," and very curious they are. Mr Nesbit, in his lectures on "Agricultural Chemistry," tells us that the whole amount of ammonia and nitric acid which descends with the rain in the neighbourhood of Paris, is only equal to a dressing of *two* hundredweights of guano to the acre—just equal to the difference in the quantity of ammonia that a crop of barley requires when it is sown very early, instead of being sown very late. Mr Lawes gives no theory for this remarkable difference.

The explanation of this fact will afford a key to an important principle in the theory of Rotations. One would be very naturally led to believe, that as barley, which was sown late, had "less time to extend its roots in search of the minerals contained in the soil," as Mr Lawes writes, it would also have less time to search for the ammonia contained in the soil. The early-sown barley or autumn wheat has far more time to search for both; but while it finds plenty of the one substance, phos-

* "The quantity of nitrogenous manure which would be necessary to raise 40 bushels of barley, when sown on the 1st of March, would be positively destructive to the crop when sown in the end of May. The analogy between turnips and barley, in regard to season and manure, is very close. Superphosphate of lime would almost have as little effect on the turnip crop as on the barley, if both were sown on the 1st March in Scotland. It would appear that, in consequence of the slowness of growth in the ungenial weather of spring, the plants can obtain the phosphate from the soil as rapidly as the development of the plants requires. But on the very same soils on which you would not increase autumn-sown wheat, or even March-sown barley, a single bushel, by applying superphosphate, you will, with a favourable season, often gain many bushels of barley by an application of the same manure when the crop is sown in the end of May."—*R. Agricultural Gazette*, Jan. 17, 1852.

phate, it fails to find the other. The facilities which the barley has of finding ammonia are vastly greater when it is sown late in spring. The objections are legion to the supposition that it has anything to do with the kind of soil with respect to its ammonia-absorbing properties. After thinking a good deal over this question, I know of no objections to the supposition that the late-sown barley can absorb, directly from the atmosphere, a much greater amount of ammonia than what early-sown can do. I cannot yet give a better explanation of this, and hundreds of other parallel facts, than I gave years ago: "When the physiological characters of plants are somewhat similar, the amount of ammonia required in manures is in the inverse ratio to the amount of heat and moisture in the atmosphere during the time the primary organs of plants are developed."*

The higher the temperature and the greater quantity of moisture in the atmosphere, the greater facilities have the leaves of plants of absorbing ammonia from the air. Less manure thus serves for late or summer sown crops. This law is a universal one. Wheat, barley, oats, rye, turnips, tares, potatoes, can all be raised with less manure (ammonia) when sown late in the season, when the temperature is high. Thus many of the cereals alter their natures altogether when sown at midsummer; they will all put forth three or four leaves at that season for one they would put forth in March.

Indeed, it appears to me that in all cases in which crops are increased by superphosphate of lime, when the soil contains a considerable quantity of phosphates, it indicates a power on the part of the leaves to absorb ammonia from the air. There seems no other way of explaining the action of this substance. For example, superphosphate, as I have long ago pointed out, is of little or no benefit as a dressing for early spring-sown turnips, barley, oats, or tares, but it is so far an effective manure for all these crops when they are sown late in the season. In beautiful conformity with this principle, I learned while I was travelling through America, that maize, millet, buckwheat, although almost identical in composition with wheat, are largely benefited by phosphates and ashes, from the fact that these crops are all sown in summer, and grow in summer. I should be glad if any one would suggest another theory for these facts than that leaves have greater facilities during warm weather of fixing ammonia from the atmosphere.

I have lately found that a great observer distinctly states this principle, and at the same time comprehends others also—

> **Gardeners do with *ordure* hide those roots**
> **That shall *first* spring, and be most delicate.**
> —***Henry the Fifth.***

* *Agricultural Gazette*, 15th May 1852.

It is almost needless to say that *ordure* signifies putrifying matters yielding ammonia. Shakespeare could not have selected a better word for the purpose of drawing the distinction between the requirements of early and late springing crops. Guano is but Peruvian *ordure.* We all know that early-sown crops require more of this substance than late. Mr Lawes' recent experiments also prove it, but the principle is not so well marked in regard to cereals in the eastern counties of England as it is in Scotland.

I suggested, four years ago, that it is highly probable that the amount of ammonia (or nitric acid) in the atmosphere is in proportion to the amount of moisture which it contains;* this might be one reason for plants absorbing a larger quantity when they grow in summer than in spring. M. Ville's experiments, in adding an additional quantity of ammonia to the air in hot houses, seem to strengthen this view. No doubt the increased vitality of the plant has much to do with it, but whatever may be the exact cause, the principle is undoubted, and must sooner or later be recognised.

I have before attempted to show that this principle gave a very satisfactory explanation of the different quantities of manure that the cereals require. It is the foundation for the idea that one kind of grain is held to be practically more exhausting than another, although they are identical in composition. Wheat, as it is well known, is considered to be more exhausting than any of the other cereals, from the fact that it requires richer manure from its being sown in autumn or early in spring. The formula which Mr Lawes has given for raising an early and a late sown crop of barley is a capital demonstration. As a curious instance which I have given before, Sir John Sinclair relates that bere hardly exhausted the ground at all, as many successive crops of this grain could be raised with little manure. It was sown later than any of the other cereals. I may return before long to this interesting branch of agricultural science; I shall therefore only give another illustration which will enable my practical readers to enter with me into that "Eden of mystery," Lois Weedon.

The oat, like barley, is also benefited by superphosphate of lime when it is sown late in the season. In Scotland, in olden times, the oat was usually sown much sooner than barley. If

* There is one circumstance that renders this highly probable. Liebig not only discovered that the air contained ammonia, but he found it in sea water also. The moisture in the air and rains are largely drawn from the sea, the water of which, in all probability, contains as much ammonia as rain water. The moisture in the atmosphere is about doubled for every increase of 20 degrees in the dew point of the vapour. The temperature of midnight is a very close approximation to the dew point. All know that warm nights promote the growth of vegetables amazingly.

the soil was in good heart, the oat plants sent out healthy leaves and began to grow at once; but, on the other hand, if the soil was poor, the plants, as soon as the nourishment contained in the pickle was exhausted, did not thrive, and for a time they looked withered and yellow. In our rural phraseology, they were said to "sit." They remained in this unhealthy state until the weather became warmer. It is now a well-known fact among agriculturists, that a dressing of Peruvian guano will make oats grow right on without any "sitting" or resting. After oats "sate" on poor land, there was an old saying very current among farmers, that the crop would not begin to grow until "the turn of the night," *i.e.* the 21st June, when the air becomes replenished with heat and moisture. These elements, as in the case of Mr Lawes' late-sown barley, at length became substitutes for a certain amount of nitrogen or guano.

In one of the discussions that took place before the Council of the Royal Agricultural Society on the Lois Weedon system of cultivating wheat, Mr Rowlandson of Liverpool stated that the success of the system depended quite as much on the crops being sown *early in autumn* as upon the extra diggings that the land received. The thin and early sowing of the crops at Lois Weedon I have always regarded as two important elements, the influence of which has not been duly weighed.

I have already stated, that 34 bushels of wheat are got, year after year, on the Lois Weedon fields without manure. Mr Lawes only obtains about 17 bushels, but he sows his wheat in the ordinary way, drilling it in at the rate of 2 bushels to the acre. Mr Smith sows his wheat in triple rows, a foot apart. These triple rows and 3-feet intervals alternate with each other. The intervals admit of the crop being hoed and cultivated up to the month of June, when the wheat comes into ear, and by this means one half of the land is well stirred. The succeeding crop is sown in the intervals that were cultivated, and next year the space that was occupied by the triple rows is subjected to cultivation.

Mr Smith sows 2 pecks of seed to the acre *as early as possible in September*, so that it may tiller before winter. I think that he stated on one occasion, that when the wheat was sown earlier it tillered so much that it had to be ploughed up. The economy of sowing wheat early in autumn is, that the plants can absorb ammonia from the atmosphere during the warmer season. The roots are formed and sent deeply into the ground, and are replenished with sap that can be drawn upon in spring.* In-

* The Marquess of Tweeddale stated this principle very clearly in his speech at the preliminary meeting of the Scottish Meteorological Association. In raising wheat at an elevation of 750 feet above the sea, he follows the practice of "sowing before

deed, autumn-sown wheat exhibits many of the characteristics of biennials and perennials in this respect. A tulip or a snowdrop, for example, lays up a supply of nourishment in autumn for its wants in spring. Or to take the instance of the turnip: if seed could be obtained from turnips sown in March, and the crop ripening in August, it is very evident that they would require to be very richly dressed with manures. But seed is obtained by superphosphate if the crop be sown in summer, for the autumn growth will compensate for manure. As Liebig says, ammonia saves time. Mr Smith's admirable system enables the wheat plant to fall back upon this principle of time, being a substitute for ammonia.

We are not put in possession of all the facts that are necessary to illustrate this part of the subject, but from certain hints that now and then appear, we gather that the early-sown wheat at Lois Weedon does not look quite so well or forward in spring as those fields adjoining that have been sown later, and dressed with rich manure. The crop, though early sown in autumn, yet looks backward in spring.* This shows that, notwithstanding the tillage which the soil upon which it grows receives in summer, there is no richness stimulating the plant to push forward in early spring. The Lois Weedon wheat undergoes a species of "sitting" in spring that we shall now notice.

Mr Kininmonth of Inverteil, a few years ago, stated to me a most important fact connected with liquid-manuring. His experience is, that liquid manure can be very advantageously applied to the grasses shortly after harvest. The manure at that season, however, had little tendency to cause the clover or rye-grass to grow much to stems or leaves, but the manure seemed then to be principally directed to the formation of roots. The ammonia was converted into juices, to be drawn upon in spring in the same way as a tulip will do. He maintains, that as heavy crops of grass will be got by dressing clover or rye-grass during the *growing weather* of September and October as by spring dressings. The autumn dressings are longer, however, in coming to maturity, as they "sit" in spring to a certain extent. But after the plants have rested over the winter, spring dressings force

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the 10th September, and the roots will have descended 14 inches into the soil before the frost commences. Wood-pigeons eat the shoots, which gives to the land the appearance of a failure of crop; as soon, however, as the *warm weather commences* the stems spring from the root, and the crop is fully as early as that of any of our neighbours."

* "During winter and up to April the plant looked so thin and so far between as to excite ridicule. The wheat then began to mat and to tiller; May came, and all through that trying month it kept its colour without a tinge of yellow. And *now* the well-tilled intervals have told upon the grain."—12th vol. *Journal Royal Agricultural Society.*

them forward much earlier, as the juices are then directed towards the formation of stems and leaves.

I have no doubt that Mr Smith's wheat crops, like the Marquess of Tweeddale's mentioned in the foot-note,* will "sit" in spring, while his neighbours', that have been manured with "10 tons of rich manure, and sown with 3 bushels of seed," will look very forward. This, as already stated, shows that the active principle is not yet within reach of the roots to stimulate the plant. The stored-up juices will only become available, like those of the oak or the grass dressed in autumn, when the temperature is sufficient to set them into circulation. The effect of this system is, that the growth of the wheat plant is thrown farther into the warmer season, and every leaf that is put out then possesses greater powers of absorbing ammonia from the air.

Indeed, Mr Smith, in presenting the facts to his readers, brings out the principle of atmospheric absorption very clearly. Describing one of his crops, he writes:†—

"There were few tillers in early spring, but after the hoeing fresh ones were thrown out so numerous, that I have counted in the stubble as many as fifty-three stems from a single grain; while the few early and original stems were growing and ripening into the dry maturity of age, these late ones were still *youthful* and *succulent* and *porous.* Then came the season of trial, the rains of summer and the fogs of autumn. The stomata of the straw were open to inhale; the sporules of the fungus entered in."

In short, something like mildew was the result. The new tillers which came up after the warm weather fed themselves. It was evidently not a feeding from the roots, because the older and "original stems" were not made over-luxuriant by the process of hoeing. But every late tiller was vascular and growthy, as it obtained a different climate to begin to grow. Very early hoeing does not produce tillering, but late stirring does so on sands as well as clays. In the light sands of Norfolk it has been long known that hoeing produces late tillers, which have a great tendency to blight.‡

I sometimes think that Mr Hoskyns is not quite so diligent a student of Tull as we should expect of him who has done so much to bring the ingenious writings of that old author into notice. It is highly proper that those who are to give the Lois Weedon system a trial, should fully understand the mildew question. This charming and elegant writer has been very unhappy on this subject. Recommending Mr Smith's system of deep cultivation in

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* See before, p. 352. † *Agricultural Gazette,* 25th September 1852.

‡ *Caird's English Agriculture.* I think it is Sir Humphrey Davy who writes, that the effect of stirring soils and admitting the air causes the roots of the wheat plants to absorb *oxygen,* which promotes tillering.

the *Agricultural Gazette*, 6th December 1851, he says, in regard to Tull's advice of not going below the "staple." "So thought Jethro Tull, who tells his followers never to go below the 'staple.' The consequence was that his wheat was mildewed *year after year*, and his system, though pregnant with after-truth, miscarried. *He never could get quit of this besetting enemy, the mildew.*" But I am sure that Mr Smith will bear me out in saying, that however deep he might dig, were he not to sow early in autumn, mildew would beset him as it did Tull. One of the most philosophical chapters in Tull's "Essay" is on "blight." He thought that "blight" arose from "insects" attacking the wheat. Let my readers, therefore, substitute *fungi* for *insects*, and *sporules* for "eggs," in the following quotation, and the agreement between Tull and Smith is most remarkable. The writings of both display great powers of observation :—

> Early-sown wheat generally escapes the blight. Another cause why some wheat is more blighted than other wheat on the same land, is the different condition in which the insects find it, for the rind of that which is very strong and flourishing is soft and tender ; in this they can easily penetrate to lay their eggs : but the wheat that is poor and yellow has a hard tough skin or rind, into which the insects are not able to bore, for the intromission of their eggs, and therefore can do it no mischief. It would be in vain to advise to prevent the blight by striving to make the wheat poor : for the poverty may preserve wheat from this blight, as well as it does people from the gout, yet that is a remedy which few take willingly against either of these diseases. *But this I think might be possible to remedy, if we could from the strongest wheat take away so much nourishment as to turn its colour a little yellowish just before the insects come, which I suppose to be in June after the ear is out, or at least fully formed.*

Tull's soil was derived from the chalk formation, and wheat on such soils, as on our moory soils in Scotland, is more liable to mildew than on some others. But I firmly believe that Tull's success in raising the crops of wheat that he did, is to be attributed to "late tillering" and "summer growth." Hence his crops were generally mildewed; he knew the "enemy" well, and has described its habits faithfully. The plants "sate" in spring, and the howing encouraged late tillers, which fed more freely upon the air. He imagined that he was feeding the plants through their roots, but he was merely giving the proper conditions for the leaves feeding themselves. I have long thought that many who write about the Lois Weedon wheat experiments, are committing a mistake exactly parallel to the one which Jethro Tull committed one hundred and thirty years ago.

The mere tillage has not so much to do with the results as is commonly supposed. By sowing thin, as is done at Lois Weedon, the wheat plants are not overcrowded in spring. The deeply-stirred soil enables them to send down large roots into the earth, which are stored by the leaves in autumn with abundance of sap.

This supply is drawn upon in spring as soon as the temperature becomes sufficiently high. Mr Smith in this way obtains as much of the summer growth as is consistent with obtaining healthy ripening plants. They are quite vigorous in May, and the wide intervals encourage a large development of leaves which feed upon the atmosphere. When the thick-sown crops of Mr Smith's neighbours are "Maying," or turning yellow, his are making up all arrears. It is not to be expected that a crop thick and sickly in spring, from overcrowding, can have the conditions for absorbing ammonia from the air: hence the economy of thin sowing with respect to the amount of ammonia which any plant may require or turn to advantage.

But take a still broader view of the matter, and this principle will become sufficiently apparent. If turnips or any other crop are planted too thickly on the ground, it does not matter how much manure is applied to them, for they cease to perform their functions in a healthy manner. Mr Smith dresses heavily for his turnips, and gives them ample room to grow, which not only allows them to assimilate the large quantity of food that is applied to their roots, but enables them to draw upon the atmosphere. His system maintains the plants in the most healthy conditions, and thus gives their capacities of growth full scope. Much has been written about the consuming power of the wheat plant for nitrogen, but the same principles apply to it as to the turnip. Without going into the other views connected with the loss of nitrogen by the wheat plant, it is easy to see that any quantity of ammonia may be lost by increasing the quantity of seed. If a field of light land, which is capable of growing 32 bushels to the acre when sown with 2 bushels of seed, were sown with 10 to 12 bushels of seed, in all probability it would scarcely produce more than the seed. The productive power of 30 bushels, which would have been available with good management, would be wasted by mere extra seeding.

Mr Lawes was led to believe that nitrogenous manures had a tendency to increase the starch in wheat. He dressed his crops in autumn, which made an earlier *and thicker* plant in spring; but the quantity of ammonia to each stalk is often actually diminished by increasing the number of stalks. Fine quality of wheat is evidently the result of a slightly unhealthy state of the crop in its first stages, finer qualities being often got when the plants turn a little yellow in May than when they are thin and growthy. Hence, so far as mere economy of nitrogen is concerned, the advantages of thin-sowing and late-growing are considerable. These are important elements in the success of Lois Weedon wheat experiments.

Tillage improves the physical condition of the Lois Weedon soils, and thus puts the plants into a healthy state, without which we have

every reason to suppose that they could not absorb ammonia from the air. But it should be borne in mind that increased vigour to a cereal that has been starved, can often be imparted by cutting it down at midsummer. This has the effect of making the roots throw out fresh tillers, which, like Lois Weedon late tillers, far exceed in size and vigour the older. This increased luxuriance is evidently leaf-imparted in both cases. In 1851 I had a field of barley completely cut down by frost on the 1st of July. The soil was very sandy. The crop was just shooting into ear, and I naturally thought all was lost. A slight shower fell in a few days, and the roots sent out strong healthy tillers, which turned out a much heavier crop than the one promised to be that was killed down. The quality of the grain was no doubt poor from its being matured in October. Mr Bell, Hilltarvit, Fifeshire, three years ago, showed me some ears of wheat that were taken from a field of grass in the beginning of November. The seed had been shed by the winds the previous autumn. The wheat plants had been twice cut as the grass was twice mowed, but the unripened roots again sent up a third crop of stems, which bore watery grains in November. Buckwheat sown in summer will grow on land upon which common wheat sown in autumn would starve.

If the advocates of the soil-absorbing theory are still inclined to believe that the chief end of the deep and double diggings at Lois Weedon is to furnish ammonia to the *roots* of the wheat, I hope they will explain the following passage from Tull according to their own principles :—

> During that long interval betwixt autumn and spring seed-times, most of the artificial pasture is naturally lost, both in light and in strong land. For this very reason is that extraordinary pains of fallowing and dunging the soil necessary to wheat, *though, notwithstanding all that labour and expense,* the ground is generally grown so stale by the spring, *and so little of the benefit of that chargeable culture remains, that if part of the same field be sown in the beginning of April, upon fresh ploughing,* WITHOUT THE DUNG OR THE YEAR'S FALLOW (!!) *it will be as great or a greater crop, in all respects* except the flour, which fails only for want of time to fill the grain.—(Chapter xii.)

This is one of Tull's beauties; and it is in entire accordance with what the authors of the Rothamsted papers style my "pet influence." As the buckwheat season is approached, in sowing common wheat the less nitrogen does the plant require to grow a certain amount of vegetable matter. The same principle comes into play at Lois Weedon. When Mr Smith falls back too far on summer growth, great luxuriance is the consequence, and the crop in July looks like a fifty-bushel one; but, alas! it ripens prematurely—the "flour fails." This does not arise from want of time to fill the grain, for the hotter the climate, the more liable is wheat to be mildewed from late sowing or tillering. It is for this

reason that in Scotland, with its cold climate, spring-sown wheat is more successfully raised than in any other country in the world, and mildew is comparatively rare. The peculiarities of the climate of Canada and the United States bring out these principles in a very marked manner. The most of our maxims in regard to the raising of wheat are upset in America. I was soon led to suspect that there were other reasons for sowing wheat so early in autumn than the severity of the winter. The wheat must tiller before winter; were it to do so in spring, mildew would follow to a certainty. We have only to remember that our climate would more nearly resemble that of Canada if our March was succeeded by July, and that month by an August which would ripen peaches in an orchard. Wheat is only raised in second-rate soils throughout America. Curious enough, I met parties discussing the Lois Weedon system of growing wheat in Southern Georgia, where wheat only escapes the mildew on the poorest sands.

It is but right to state that the Lois Weedon soils are of good natural fertility. "The field," writes Mr Smith, "that I am describing is a gravelly loam, with a varied subsoil of gravel, clay, and marl. It has been hard-worked for nearly a century; it has never known a bare fallow in the memory of man, and my operations followed immediately after a heavy crop of wheat sown broadcast." I would be very far from claiming that growth during the warm season is capable of saving more manure at Lois Weedon than it is legitimate to do so. I have little hesitation in saying, however, that it would be quite equal to the saving effected in sowing a barley crop late in season, as in the case that I selected for illustration from Mr Lawes' experiments. On the deep trap soils in Scotland, I am quite justified in saying that land, upon which a crop of wheat had been taken that would not produce a half crop of barley when dressed with superphosphate, and sown early, would produce, when similarly dressed, two-thirds of a crop when sown late. A field which would only raise 20 bushels of wheat in America, would raise from 40 to 50 of Indian-corn. A field fit for raising 8 bushels of wheat would raise 20 of buckwheat. I have every reason for believing that on soils of the same fertility an untilled acre of sugar-cane will yield far more vegetable matter than two crops of well-cultivated Indian-corn.

But Liebig's law must never be forgotten, that ammonia is not peculiarly fitted for one kind of cultivated plant more than another. His is a very simple law that applies to all the families of plants. It is often said that grain and grasses are most fitted for ammonia, but there is no evidence that they are so. Ammonia (or nitric acid) is the universal food of plants, only some have greater capacities for it than others. Indeed, the rule of not too much is as applicable in the vegetable as it is in the animal world. Some plants are grosser feeders than others; while one

thrives best when this kind of food is diluted, another when it is more concentrated. The capacity of individuals for ammonia has often apparently been taken as a standard for measuring that of the whole family of plants to which the individuals belong. The leguminous hop requires more ammonia than the white clover, because it is capable of growing to a much larger size. A cabbage or a beet-root is a gross feeder, more so than a swede; but the swede exceeds the common turnip, and the common turnip the wheat plant. Many grasses yield abundantly under a liberal supply of ammonia, but the majority do not. Italian ryegrass, no doubt, may be regarded as the greatest glutton of all the plants we cultivate; but while some species of grasses wallow among the foul sewage of our towns, others "batten on the moor," and to them ammonia, in a concentrated form, is poison. Each species has its own capacity for ammonia; up to a certain point it thrives; beyond that is excess, which induces plethora; in short,

> "Being over-proud with blood and sap,
> With too much riches it confounds itself."

I have thus so far given an outline of the different facilities which plants possess of extracting phosphates from the soil. I have also endeavoured to trace out the meteorological conditions which give *facilities* to plants to extract a portion of the ammonia that they require from the atmosphere. Indeed, if plants had not the power of abstracting ammonia directly from the air, their *facilities* of abstracting it from the soil would require to be inverse to their *facilities* of abstracting phosphates. Thus, while a crop of late-sown barley had little power to abstract phosphates, it still had great power to abstract ammonia; while an early-sown crop had little for ammonia, it had much for phosphates. But if my readers have still any doubts remaining that plants do have the power of absorbing ammonia directly from the atmosphere, all doubts on this subject will vanish when we further consider the other facilities which different plants possess of absorbing ammonia from the atmosphere. It appears very strange why our writers on vegetable physiology have overlooked some elements in this question that throw much light on the action of manures and the principles of a rotation of crops.

Indeed, Tull and all the ancient writers on agriculture took a very exaggerated view of the effects of mere tillage. So are we all apt to do when we gaze upon the formidable appliances of which modern agriculture can boast for subduing the ground and making it available for our wants. I shall quote a short passage from the writings of a most distinguished philosopher in the science of political economy. I am persuaded that this affords an excellent position, from which we may overlook the whole theory of agriculture, if we only take Liebig as our guide.

"The most important operations of agriculture," says Dr Adam Smith,* "*seem intended not so much to increase*, though they do that too, *as to direct the active fertility of nature towards the production of the plants most profitable to man.* A field overgrown with briars and brambles may frequently produce as great a quantity of vegetables as the best cultivated vineyard or cornfield. *Planting and tillage regulate more than they animate the active fertility of nature.*"

This is rather a humiliating view of agricultural results, after all our efforts in ploughing, hoeing, and manuring. It is nevertheless a true one. The statistics collected by the Highland Society show that the average produce of wheat, barley, oats, beans, and pease, is only about 4 quarters of grain to the acre—some three-fourths of a ton of vegetable matter; and if we add a ton for straw, this would only be a ton and three-fourths altogether. Nor will the watery turnips and potatoes bring up the amount of dry vegetable matter above 2 tons. But just allow Nature to have her own way, and we see results as great. Mr Brown, in his article on "Arboriculture," in the *North British Agriculturist* of 30th January last, brings out the curious fact as the result of laborious investigation, "that 218 tons of pine *wood* are produced from one acre of land in the north of Scotland in the course of a century; or, in other words, it is proved from this that even land *of very poor quality* is capable of producing wood at the average rate of fully 2 tons per acre per annum;" and besides this a great weight of branches and leaves. The soil also becomes enriched with vegetable matter in consequence of the roots which fill the ground and the leaves which fall, whereas the more we till, the more we exhaust.

Pines on poor land untilled and unmanured, it would thus appear, are capable of assimilating as much oxygen, hydrogen, carbon, and nitrogen, as our average crops do on the best land by mere tillage. What advantages have the natural vegetation over that which is pampered by art that the results are such?

Let us study for a moment the habits of the lichen that grows upon the indurated rock, and all will become clear. It subsists entirely upon water, earth, and air. Its slow growth is characteristic of the greater number of its order, and thus it seems to obtain nourishment from the flinty rock as fast as it is capable of growing. Its constitution does not admit of its expanding beyond a certain limit in a given time. It can subsist where others would starve, and therefore no other plant can compete with it. But it can readily be seen that these slow-growing habits unfit it for other situations, where faster-growing and larger plants would soon overgrow it, and occupy its place. It only maintains its hold upon the

* *Wealth of Nations*, book ii. chap. 5.

rock by sheer economy. While it can afford to shed its crop of seeds annually to the winds, it cannot afford *to renew its roots and other organs every year*. Indeed, the *perennial vitality of the roots and leaves* of the lichen enables it better to dispense with manure.

In the nobler specimens of the vegetable kingdom a better view is got of the physiological peculiarities of plants, which give them greater facilities for absorbing carbonic acid and ammonia from the atmosphere, and minerals from the soils. The oak does not increase very fast for some years after it has sprung from the acorn. It expands, however, more rapidly with the increase in the size and number of its branches, which support a larger surface of leaves to feed upon the food contained in the atmosphere. Every function of the oak is also subservient to an economical system of vegetable production.

The oak casts away nothing but its leaves on the approach of winter, and before it does so it replenishes all its vessels by their aid with vital sap, which is stored up and ready to be transformed into buds and leaves on the approach of summer. A genial temperature is all that is required to push out the leaves, which prey upon the air, and make a grateful return to all parts of the living structure. While the acorns are growing and ripening, the leaves are furnishing the necessary materials.

But as the branches and leaves multiply, greater facilities must be given for obtaining more phosphate and earthy substances to grow more acorns. In this department also great economy reigns. It is a comparatively easy matter to pluck up the young sapling, which only gains possession of the soil by degrees, but what is gained is never lost. The roots penetrate amongst rocks and stones in search of food. All is accomplished without any force external to itself. It does not require the aid of the plough, the hoe, the clod-crusher, or the harrow. A full-grown oak has the greatest facilities of abstracting phosphates from the soil, as well as ammonia from the atmosphere.

When the leaves fall off in autumn, the whole accumulated capital, in the shape of roots, trunk, and branches, is carried to the next year's account, to have another year's profits added. The oak may be said to enrich the soil by beginning with little, and going on with a system of compound interest, which quickly runs up. It is easy to see that it could not absorb a maximum amount of yearly increase from the atmosphere before it had organs to do so. In short, it could not have its full complement of leaves without a corresponding number of twigs to hold them; nor twigs without branches; nor branches without a trunk and a countless host of roots. Why then, old Jethro, doth it not appear pretty evident that since "air" and "water" is "the food of plants," roots, trunk, branches, and leaves, render "dung or

tillage" quite unnecessary? You once stumbled upon the truth when you said, "Men till the ground because they find tillage procures better food than acorns."

It is perennial vegetation that covers the surface of the earth in a state of nature. Annual plants rarely impart a feature to the natural landscape. Perennials have not everything to do in one season, but every year adds strength and power to their hold until they firmly take possession of the ground. It is only when some catastrophe overtakes the perennials—such as fire, floods, or the plough—that the annuals have a chance to clothe the surface of the ground. Indeed, as Liebig has pointed out, the vigour of annuals seems quite as great as perennials in the first year's growth; but by unrelaxing efforts on the part of the latter they soon gain the mastery, and exclude their more helpless rivals. However numerous and troublesome annual weeds may be in the fallow or the corn-fields, the thickly-matted carpet of tiny grasses in the pastures keeps them all under.

Perennial vegetation often exhibits considerable luxuriance on soils which are very poor in organic matter, but the larger class of annuals are never seen growing with any vigour on such soils. In fact, annuals must be so far regarded as a sort of parasites. A poor soil may cause a perennial to delay producing seeds, but through its economical habits it will thrive where an annual would be starved. This very day that I pen this passage, I saw a small gooseberry-bush growing on the top of a wall 5 feet from the ground, and bearing large numbers of fruit. In such a position an annual would hardly have subsisted. The thriftless annual casts away its roots and stems, and the soil must be supplied with an equivalent in the shape of manure before it is placed on a level with the perennial, which keeps up these appendages in a vital state. Hence the comparative dependence of annual plants.

That plants derive ammonia directly from the atmosphere, is, I think, demonstrable from the fact that the larger class of perennial vegetation is independent of an artificial supply, and yet assimilates as great a quantity of oxygen, hydrogen, nitrogen, and carbon, as our manured crops do. It appears to me that unless plants had the function of absorbing ammonia, that of absorbing carbonic acid would be a useless one. Barral's experiments on rain water show that the ammonia and nitric acid that fall on an acre per annum is equivalent to 2 cwt. of guano. Is this sufficient to maintain natural vegetation where the surface is covered with plants and the soil untilled? If clay soils really possessed the power of absorbing ammonia that some suppose, the growth of cereals or annuals of any kind should not exhaust the soil so rapidly as they ordinarily do, nor should annuals be more dependent than perennials on such soils. Apples are nearly of the

same composition as turnips, yet if the chemical conditions of the soil are favourable, apple trees may bear large quantities of fruit year after year on mere gravels without manure of any kind; but even to produce the same weight of turnips the soil would require to be well tilled and manured. A crop of grass would be got in addition in an orchard, and yet there would be no exhaustion. Land under wood is as virtually exhausted to the extent of the year's growth, so far as it has obtained it from the soil, as if it had been carted off. Still there is no exhaustion in a forest if the substances found in the ashes of trees are abundant. But the increase of wood in a tree becomes the solid framework of a still more complete system of exhaustion—a more perfect system of exhausting substances from the soil and substances from the atmosphere; and since the soil (as I have supposed) and atmosphere contain what is wanted in inexhaustible quantities, as a strange illustration of the maxim that extremes often meet, a plant, such as an oak, which is a complete exhauster (of the soil and atmosphere), is practically and justly regarded as no exhauster at all.

The more nearly that an annual plant approaches in its habits to a perennial, the more can it rely upon the atmosphere for a supply of ammonia. All perennials carry on two processes at once—the process of flowering and forming fruit, and that of putting forth fresh leaves. Cereals are always diminishing their leafy surfaces as soon as they begin to put forth their ears; and as their glassy stems are not fitted for absorbing ammonia from the atmosphere, they must draw it from the soil. Beans, pease, and tares, and a great number of annuals, put forth fresh leaves the most of the summer. The fresh leaves are, like Mr Smith's or Tull's late wheat-tillers, or Mr Lawes' late-sown barley, greedy absorbers of ammonia from the atmosphere; and as they approach in these characters to the grasses, they are not so dependent of a supply of ammonia.

Buckwheat exhibits in a very marked manner a fine illustration of the influence of temperature, combined with the physiological peculiarities of plants, in determining the comparative facilities which some have for relying upon the atmosphere. Of all the annual plants that are fitted for supplying man with bread, buckwheat is the one which will grow on the poorest soils. The chief reasons are that it is sown in summer, which gives it greater facilities of absorbing ammonia from the air, and that it exhibits perennial tendencies in constantly sending forth fresh leaves and blossoms even when some of the seeds are ripened.

Such then is a mere outline of the meteorological conditions and of the physiological peculiarities of plants which impart greater facilities to plants obtaining food from the atmosphere and food from the soil. To these interesting subjects I may return at some

future time, and show the application of the same principles to other crops which exhibit interesting varieties.

In conclusion, my readers may bear in mind that annuals supply man with food in the temperate latitudes. Such plants, having no perennial roots or leaves, must have this deficiency made up. The soil must therefore be carefully cultivated and manured. The implements of the husbandman show how dependent are the plants which he rears upon his care; and if that care were withdrawn, how soon the ground would be again occupied by the "briar and the bramble." Thus we must "earn our bread in the sweat of our face."

It is in the tropics, where "spring and autumn dance hand in hand," that we perceive the luxuriance of perennial vegetation contrasted with that of annual. Humboldt, struck with the difference, styles the former "the wild abundance of nature;" and where the inhabitants rely for a subsistence upon large evergreen trees that bear fruit nearly all the year round, "the penalty of Adam—the season's difference," falls lightly upon them. Without manuring or tillage, what results are obtained? I cannot do better than conclude this paper in the language of the astonished Captain Cook: "Whoever has planted ten bread-fruit trees has fulfilled his duty to his own and succeeding generations as completely and amply as an inhabitant of our rude clime, who, throughout his whole life, has ploughed during the rigour of winter, reaped during the heat of summer, and not only provided his present household with bread, but painfully saved some money for his children."

THE FOOD OF LONDON.*

ALMOST every light in which we can regard the metropolis of England is interesting and instructive. It is such an assemblage of human beings as never before lived together; it presents us, therefore, with social phenomena on a scale of unexampled magnitude, which either gives rise to features entirely new, or invests old ones with unwonted and singular aspects. It seems to be admitted on all hands, that since the census of 1851 the population has greatly increased, and that at present it cannot be less than two millions and a half. It has been calculated that if all things affecting the population advance in the ratio they followed between

* *The Food of London*; A sketch of the chief varieties, sources of supply, probable quantities, modes of arrival, processes of manufacture, suspected adulteration, and machinery of distribution, of the food for a community of two millions and a half. By GEORGE DODD. London: Longman & Co. 1856.

1841 and 1851, the inhabitants of London will, in 1863, amount to three millions; in 1878, to four millions; and, in 1889, to five millions. But this is a result concerning which it is needless to speculate, for we shall probably never see it realised; the proportion of our urban to our rural population is already so great that it must soon find a limit in the nature of things. It is probable that it has already nearly reached its maximum, for influences are now beginning to operate which tend rather to diffusion than to that excessive centralisation which is equally undesirable on physical and moral grounds.

It is easy to say that London contains a population of two millions and a half; but we believe that, in most cases, the mere recital of large numbers conveys no definite idea to the mind. It is like a statement of the distances from us of the stars and planets, or of the velocity of light, which, after puzzling ourselves over a formidable array of figures, we can only feel to be indefinitely great. It may serve to give a more graphic and tangible form to the subject to say, that such a population exceeds that of Norway, or Hanover, or Saxony, or Switzerland, or Tuscany, or a dozen of the smaller states of Germany; that it is equal to that of Denmark, five-sixths as many as the whole of Scotland, as numerous as that of the five departments of Normandy! And if it is not easy to convey a precise conception of its multitudes, neither is it easy to define its superficial extent. If it is not boundless, it may almost be said to be without bounds, for there is scarcely any distinct line of demarcation which separates it from the country. You scarcely know when you enter London, or when you leave it. The *City* is merely the central nucleus of the mass, from which recede on all hands, like circles formed in water, interminable lines of building; these at length become broken down into insulated patches, which in their turn give way to a surface dotted with houses, which become more and more scattered, till they at last disappear. But instead of terminating in the country, they may merely lead you to some populous suburban village, leaving you in doubt whether it has any independent existence, or is merely an outlying portion of the mother-city. Owing to this uncertainty as to its limits, London is frequently spoken of in different senses, a circumstance which gives rise to numerous errors. There is the "Registrar General's," London, which comprises the two cities, London and Westminster, the borough of Southwark, the forty out-parishes, and about seventeen suburban villages and hamlets. The "Poor Law" London, again, and "Parliamentary London," are both somewhat more restricted than this. The "Post-Office" London gives geometrical symmetry to the metropolis, by confining it within a circle of a given number of miles radius; while "Police London" stretches away fifteen miles in every direction from Charing Cross;

in other words, embraces a circle whose diameter is thirty miles! *

One of the most curious and important inquiries to which this extraordinary congregation of human beings gives rise, is the manner in which they are supplied with food. On this subject it is the object of the work cited above to furnish us with information, and it affords a great variety of curious details, digested in a very instructive and attractive manner. If we are sensible of a deficiency in statistical facts and precision in results, this arises rather from causes inherent in the subject itself, than any want of care or ability on the part of the author. No previous work has treated of the subject collectively; the materials were to be sought for in an almost endless series of journals and periodicals; in the reports and statistical tables published by Government; in the chemical and dietetic works of scientific writers; in old diaries and household books; and other sources of a similar kind. To the materials thus obtained the author has added considerably by his own personal inquiry and observation, and has placed the whole subject on as satisfactory a footing as the existing state of information will admit of. Owing to the manner in which business is conducted in many of the London markets, no accurate account is kept of the quantity of produce disposed of, so that, in most cases, a vague approximation to the actual amount, both of consumption and supply, is all that can be attempted. Much additional value and interest are given to the work by a historical sketch of the food of London in past times, and the changes that have taken place in the habits of the people in reference thereto. We are thus placed in a condition to estimate more correctly the important changes that improved methods of transit have produced in recent times. Of these the first, in point of time, may be said to be canals, which, ramifying through the country in all directions, afforded facilities for the conveyance of inland produce, especially of a heavy or bulky kind, previously unknown. To these succeeded steam navigation, which partly, but only in part, superseded canals, and brought remote places within easy distance of each other. But the most momentous change of all, it is scarcely necessary to say, was brought about by railways, which render almost every edible product of any part of the kingdom available for the London market, without enhancing the price beyond what is readily paid. This change, indeed, is so great as almost to amount to a revolution.

The "food of London" is a topic which, at present, can be treated of only as a part of a larger subject—namely, the food-supply of the United Kingdom at large. In the kind of its food

* Baron Dupin affirms that London occupies a territory equal in superficial extent to the whole department of the Seine. We may mention, for the purpose of comparison, that the present population of Paris is considered to be 1,500,000.

the monster city may be said to be almost omnivorous; in quantity it is all but insatiable. It consumes a large proportion of every kind of comestible imported into the country, and not a few articles are exclusively reserved to gratify its own gastronomic peculiarities. Much information will therefore be found in Mr Dodd's book, of a general kind, not only regarding the articles of food used generally in this country, but also the beverages in common use, and even drugs, tobacco, and other collateral matters, and all the varied interests to which they give rise. Into the consideration of most of these topics it would be out of our province to enter; but a few subjects are touched upon of general interest to agriculturists, and it may be useful to lay before our readers some of the information of this nature which the work supplies. The momentum with which London acts on all the food-producing classes in this country is very great, and is likely for some time to increase. The connection which subsists between London and Scotland, in regard to agricultural produce, is already considerable, and is likely soon to be carried much further, to the mutual advantage of both.

Some of our best national characteristics, which are well known to be derived from the roast beef of old England, ought to be improving with the quality and more abundant use of the substance to which they owe their birth. Yet it must have been singularly efficacious to produce the effects ascribed to it in former days, when we consider not only its very indifferent character, but its limited supply. Excepting in the principal towns, the mass of the people received their chief supply of meat from the feudal barons and rich monasteries. As there was little winter-feeding for cattle, the animals were slaughtered in October and November, and put into brine: there was thus a large supply of salt meat for the better classes; but salt fish was the staple winter food of the people; and this, unrelieved by a sufficiency of vegetables, gave rise to many diseases. "The remarkable "Household Book" of the Earl of Northumberland belongs to the next following century, but the details there given concerning the supply of meat apply equally to the century now under notice (the 15th). Hume, commenting on this book, seeks to show how little of the "roast beef of old England" could have fallen to the lot of the people in those days. We are told that 109 fat "beeves" are to be bought at Allhallow-tide, besides 24 lean beeves; the latter are directed to be put into the pastures to feed, and to serve from Midsummer to Michaelmas. Now, this autumnal period was the only time during which the earl's family, consisting of 223 persons, could obtain fresh beef; during the rest of the year the beef which they ate was salted. Besides the "beeves," there were 620 "muttons," which were also eaten salted, in all except the autumnal months; the 28 "veals," 25

hogs, and 40 lambs, were probably reserved for his grace's table; the servants ate salt meat, accompanied by very few vegetables. Working-men out of doors, we may assume, fared no better than the servants of a grand noble. It was this which led Hume to say that there cannot be anything more erroneous than the magnificent ideas formed of the "roast beef of old England" in those days (p. 39). How could it be otherwise? The breed of cattle was of the poorest description; every branch of agriculture was in a wretched state; the artificial grasses and the most valuable root-crops scarcely known; stalling or house-feeding was not practised; it was with difficulty the cattle could be kept alive through the winter. What a contrast now! Young England regales itself with beef of the finest quality at all seasons of the year; and the quantity with which it is supplied to the London markets may be judged of from the following written picture, composed out of the dry materials of statistical returns and numerical calculations:—

If we fix upon Hyde Park as our exhibition-ground, and pile together all the barrels of beer consumed (annually) in London, they would form a thousand columns not far short of a mile in perpendicular height. Let us imagine ourselves on the top of this tower, and we shall have a look-out worthy of the feast we are about to summon to our feet. Herefrom we might discern the great northern road stretching far away into the length and breadth of the land. Lo! as we look, a mighty herd of oxen, with loud bellowing, are beheld approaching from the north. For miles and miles the mass of horns is conspicuous, winding along the road ten abreast; and even then the last animal of the herd would be seventy-two miles away, and the drover goading his shrinking flank considerably beyond Peterborough. On the other side of the Park, as the clouds of dust clear away, we see the great western road, as far as the eye can reach, thronged with a bleating mass of wool; while the shepherd at the end of the flock (ten abreast), and the dog that is worrying the last sheep, are just leaving the environs of Bristol, 121 miles from the beer-built pillar. Along Piccadilly, Regent Street, the Strand, and Cheapside, and the eastward Mile-End Road, for seven miles and a half, street and causeway are thronged with calves, still ten abreast; and in the great parallel thoroughfares of Bayswater, Oxford Street, and Holborn, we see nothing for nine long miles but a slowly-pacing, deeply-grunting herd of swine. As we watch this moving mass approaching from all points of the horizon, the air suddenly becomes dark, a black pall seems drawn over the sky—it is the great flock of birds, game, poultry, and wild-fowl that, like Mrs Bond's ducks, are come up to be killed. As they fly, wing to wing and tail to beak, they form a square, whose superfices is not much less than the whole enclosed portion of St James's Park, or fifty-one acres. No sooner does this huge flight clear away, than we behold the Park at our feet inundated with hares and rabbits; feeding two thousand abreast, they extend from the Marble Arch to the Round Pond in Kensington Gardens, at least a mile.*

To the mighty army composing this moving panorama, both Scot-

* *Quarterly Review*, No. cxc.

land and Ireland contribute largely; the former, cattle and sheep; the latter, cattle, sheep, and swine. Ireland has benefited in a very high degree by the advantages accruing from improved modes of transport.

The formation of railways from Holyhead and Liverpool to London, and from Cork, Limerick, and Galway to Dublin, combined with the establishment of steam transit across the Channel from Dublin to Holyhead, have largely facilitated the power of Ireland to aid in supplying London and other large towns in Great Britain with animal food. At the great annual fair at Ballinasloe there are on some occasions cattle sold to the value of a quarter of a million sterling.

The Irish pig is perhaps better known in the metropolis than the Irish ox. On his way to London, or any other part of England, he frequently passes through some such ordeal as the following: The Irish pig-farmers, unlike the English sheep-farmers, have very small herds; indeed, Paddy's riches not unfrequently consist in one single pig, whose duty and destiny it too often is to "pay the rint." Such a state of things gives rise to a system of job-trading. Pig-jobbers are very numerous in Ireland; and in the dealings between them and the small farmers and cottiers there is much fun and blarney, much waste both of words and of time. Most of the pigs thus purchased in the interior of Ireland are either sent to the nearest shipping port, by road or rail or canal, or are taken to establishments where they are further fattened for the market, and then sold to the pork-curers of Cork and its neighbourhood.—(P. 226.)

As with all other live stock sent to the London market, it is difficult to determine clearly the precise number of animals that reach it from Ireland. Taking an average of four years, 1846-7-8-9, the number was estimated at about 200,000 cattle and calves, 250,000 sheep and lambs annually. Since that time it has no doubt much increased.

A similar uncertainty exists with regard to the number of Scotch cattle and sheep disposed of in London; but this branch of trade is evidently in a progressive state, and means will probably be taken to make us better acquainted with the particular details of it. The nature of food-transit to the metropolitan markets in past days cannot be better illustrated than by the Falkirk Tryst, and the proceedings thence to the arrival at Smithfield; but these are sufficiently familiar to most of our readers. Droving on a large scale, and for great distances, which was in former days attended with a good deal of exciting adventure and picturesque accessories, which Sir Walter Scott has not failed to take advantage of in some of his tales,* is now giving way to more rapid and profitable modes of conveyance. The length of time spent in cattle-driving to the southern markets, and the expenses thereby incurred, well exemplify the truth of the modern commercial maxim that "time is money."

* See the tale of the "Twa Drovers."

As in the central parts of Scotland, so was it also in the Galloway district, subject to minor variations. The Galloway cattle were sent southward by thousands every year to be fattened for the London butchers. They were purchased by jobbers or dealers at the various cattle fairs in the south-west of Scotland; they were collected into droves of many hundreds, and driven south-east to Norfolk and Suffolk. The topsman of each drove made arrangements for their rest at different stations, and took care that grass, hay, or turnips should be forthcoming. The journey lasted about three weeks; and it affords a striking proof of the costliness of this slow mode of travelling, that the total expenses, when divided by the number of cattle, varied from 24s. to 34s. per head. The prices paid by the jobber ranged from £3 to £12 per head, according to the age and excellence of the animals; and thus the jobber's venture became one of some magnitude. The Norfolk and Suffolk graziers bought the cattle for the purpose of fattening for Smithfield; and it sometimes happened that, in unfavourable states of the market, the jobber was forced to sell at prices which subjected him to a loss. A jobber of more slender means would make smaller purchases, and drive his herd over the border, to sell at the first English fair which would afford a chance of profit. There were thus frequently two graziers and two jobbers concerned in the ownership of a bullock, at successive periods, before the animal reached Smithfield; and during this time the poor beast had to travel four or five hundred miles on foot. Some parts of this complex system are still kept up, but great changes have ensued in other particulars. —(P. 110.)

Railway conveyance has the advantage of preventing the loss of weight which cattle suffer from long travelling on foot. Mr Harding forms an estimate, from facts carefully collected, that when cattle are driven along a common road, they lose on an average 20 lb. per beast in a journey of 100 miles, that sheep lose 8 lb., and that pigs lose 10 lb. No wonder that this mode of conveyance is producing such important changes; and we should be prepared to expect such results as the following: In 1853, the seven railway companies brought nearly twelve hundred thousand head of live stock to the metropolis; and in the following year more than two millions of oxen, calves, sheep, lambs, and pigs reached the same destination by railway and steamers together.

One of the important results of rapid conveyance—by steam and rail—is the great quantity of country-killed meat now transmitted to London. The operations connected with slaughtering can be executed at less expense in the country, and there is a saving of freightage or carriage for hides, hoofs, horns, &c., which remain in the country, where they can be sold to as much advantage as elsewhere. Most of the Scotch meat sent to the metropolitan markets formerly went by sea; but the railway companies have made a resolute effort to compete with steamers, and as the transit is shortened by railway, the inland conveyance has taken the precedence. The railway companies charge from 1s. 6d. to 4s. per cwt. for bringing meat to London from the Midland

counties, according to their distance. Accounts vary considerably as to the quantity of country-killed meat brought to London. Mr Mayhew stated, in 1849, that the quantity of dead meat sold annually at Whitechapel market was about 70,000 stones of beef, 108,000 stones of mutton, 148,000 stones of pork, and 73,000 stones of veal; the whole amounting to above 3 million of pounds. The quantity sold at the same time in Leadenhall market was estimated at 580,000 stones of beef, 950,000 stones of mutton, 450,000 of lamb, 540,000 of pork, and 400,000 of veal—making a total of nearly 3 million of stones, or 24 million pounds. In that same year, the East Counties Railway brought 600 tons of dead meat to London weekly; and two carrier companies brought about 30 tons per day from Camden station to Newgate market. 17,000 tons of meat and poultry were conveyed to London in 1854 by the Great Northern. In the year 1850, it is affirmed by Mr Braithwaite Poole, that 67,500 tons of country-killed meat were brought to Newgate and Leadenhall markets alone, of which 20,000 tons were conveyed by the Eastern Counties Railway. But it will tend to show how vague most of these statements or calculations are, when it is added that a writer in the *Quarterly Review*, who seems well acquainted with the subject, mentions only 37,000 tons as the quantity brought by all the railways and Scotch steamers in 1853, by which time we should have been led to believe, from other sources of information, that the quantity had increased rather than fallen off.

There are three principal meat-markets in London: Newgate, Leadenhall, and Whitechapel. They are supported by certain tolls, paid by those who make use of them. Thus, the salesman at Newgate pays a penny for each "hamper" of meat, twopence for a "bundle" of meat, and sixpence for a "pack;" and the other dealers pay for the privilege of bringing in poultry, and game, and other eatables into the market, besides paying rent for the shops and stalls. At Leadenhall, in like manner, there are charges of a few pence for a "tray of beef," a "quarter of beef," a "hamper of meat," and so on. Owing to the manner in which the tolls are charged, no regular account is kept, nor is indeed practicable, of the total amount of meat brought in or sold; hence the unsatisfactory nature of the statements made on this subject. An idea of the enormous extent of the sales may, however, be formed from the estimates of the value of them, made by Mr Giblett, in 1849. He calculates that the animals slaughtered in London for sale at Newgate market are worth about one million sterling annually; that the country-killed meat sent up to the same market is three times as large in quantity; and that the whole amount of Newgate market sales would thus be nearly four millions sterling annually! The average price assumed in this calculation was 2s. 10d. per

stone, a price then deemed too low; if based upon the present rates, what a large addition would be made to the sum total!

The mode of transacting business in these markets will be learned from the following extract regarding Newgate, which is unquestionably the largest dead-market in the kingdom:—

The market is held every day in the week, but Mondays and Fridays are the chief market-days. Business commences so early as four in the morning, and it is "high change" between five and seven; by nine or ten o'clock the larger dealings are concluded; and when the principal salesmen have consigned over to smaller salesmen any meat that may yet remain unsold, they close their shops and retire for the day. There is an afternoon sale for the convenience of butchers who have been to the cattle market, and who may wish to purchase dead meat before returning home. There are also evening markets, especially on Saturday, for the sale of any remaining stock; but butchers have nothing to do with this; the purchases are made by the humbler class of consumers.

The system of transacting business here is analogous to that at the cattle market. The salesman is the medium between the seller and the buyer. A grazier or dealer, in any part of the three kingdoms, writes to his salesman to announce that a certain quantity of killed meat will reach London by railway or by steamer at a particular time; and the meat arrives in waggons, or vans, or carts, from the station or the wharf. How these vehicles can take up their places in the narrow thoroughfare of Newgate Street is almost inexplicable. No time is lost, however. The blue-jacketed porters are ready to carry the meat from the carts into the salesmen's shops; and if a black hat or a black coat should chance to be in one of the narrow avenues at the time, a shouting of "Time's up, Guv'nor," and probably a thump from a huge piece of beef will suggest to the owner of the hat or coat the expediency of getting out of the way as quickly as possible. When the butchers arrive, purchases are made and money paid with great rapidity. The salesman charges a small commission to the grazier or country dealer, and, with this deduction, transmits the money by any of the usual modes adopted in commercial transactions. He may not see his employer from one year's end to another, or may indeed be personally altogether unknown to him; for the transactions are managed with so much regularity, that a penny-post letter will be as efficient as a personal conference. The salesman's commission is so trifling as a penny or three half-pence per stone of 8 lb.; it is the same whether the market-price of meat be high or low; and on this account, when the meat is cheap and the demand brisk, the salesman's profits are greater than in a time of high prices and a slack demand. The salesmen pay a weekly rental for their shops or stalls; and it is they who employ the porters that bring the meat from the vans and carts into the shops.—(P. 270.)

We may allude to the system of calf-fattening for the London market, which, like all operations relating to the supply of the metropolis, is conducted on a large scale, for the sake of the curious question in agricultural economics which it involves,—namely, whether it is more profitable to convert milk into veal, or into butter and cheese? This department has undergone little

alteration from railways, and is conducted nearly as it was twenty years ago. The calf-fattener keeps several cows, selected with a special view to their milking qualities; each cow suckles her own calf, and also another calf, if the milk be sufficiently abundant. In about ten weeks the calf becomes "prime veal;" it weighs perhaps 17 to 20 stone of 8 lb. each. A calf grows and fattens more rapidly after it is ten weeks old than before, and beyond that age the veal is regarded as not so choice. The calf-fatteners are supplied by a class of men called calf-dealers, who perambulate the dairy districts with carts, and buy up all that are to be disposed of. The calves were formerly sold to the fatteners at prices varying from 20s. to 35s. when the animal was about a week old, and nine weeks afterwards they would command a price of £4 to £5 at the London markets. Considerable as this profit may seem, it does not appear, from certain calculations that have been made, that this is the most advantageous method of employing milk. The experiment has been tried as to what 100 gallons of milk would effect, in suckling a calf for veal, in making butter and cheese. The result stands thus:—

100 gallons of milk produce 112 lb. of cheese, worth 6d. per lb.	£2	16	0
And 5 lb. of whey butter, worth 8d. per lb. . .	0	3	4
	£2	19	4
100 gallons of milk produce 34 lb. butter, worth 10d. per lb.	£1	8	4
And 74 lb. of poor cheese, worth 3d. per lb. . .	0	18	6
	£2	6	10
100 gallons of milk produce veal to the value of about .	£1	17	0

It may readily be supposed that the meat markets of London are not more free from rogues than other branches of trade. Here indeed they cannot absolutely substitute another material for the real one, but many methods are employed to enhance the apparent value of an inferior article, and even to render attractive what is unfit for human consumption. However bad may be the condition of the meat sent to market, there are never wanting persons in London ready to purchase it; it serves to concoct those steaming messes which are sold at a low rate among the poor. Such meat is sometimes sold at the rate of a penny per pound. A vigilant inspection is always, however, exercised; and in the space of one month as much as 48 quarters of beef, 56 sheep, 8 pigs, and 5 calves, have been condemned in Newgate market. It is easy, at the same time, to perceive that meat may frequently reach the market in a state unfit for use, where no deception was intended: a casual detention, or a particular state of weather, may induce a taint in what otherwise would have been quite fresh.

After going through many singular vicissitudes, and struggling

long and successfully for a prolonged existence, although denounced almost on all hands as an intolerable grievance, Smithfield market, like Bartholomew Fair, has at length ceased to be.

Never perhaps (our author well remarks), did any other country see so extraordinary a market; never, in all probability, shall we again witness such another market in our country. It was a continued struggle against difficulties, almost against impossibilities; a continued protest against the dictates of good sense; a continued manifestation of prejudiced adherence to an old system; a continued display of the meat-buying powers of the London public; and, not less important, it was a sort of perennial declaration of the wonderful improvements gradually introduced in the size, quality, and condition of grazing-stock.—(P. 233.)

The magnificent market intended to supply its place, projected on a scale commensurate with the still increasing requirements of the metropolis, is situated in Copenhagen Fields, abutting on Maiden Lane or York Road on the west, reaching nearly to the Camden Road villas on the north, bounded by the North London and Great Northern railways on the south, and having three outlets to the Caledonian Road on the east.

Its contiguity to the railways (says our author), is very important; for by the construction of a few small branches, all the lines round London could be brought into connection with it—and most probably will be so ere long. No less than 75 acres of land were purchased by the Corporation; but the actual market covers 15 acres, while the lairs, &c. absorb about as much more, leaving an ample surplus for future contingencies. At £800 per average acre, the cost amounted to £60,000 for land; while the total outlay for land and works nearly reached £400,000.

The market itself forms a square area, paved throughout with granite, surrounded by a handsome railing with gates, ornamented with a lofty clock-tower in the centre, and provided with an abundant supply of water. In its present state, it could accommodate 36,000 sheep, 6400 bullocks, 1400 calves, and 900 pigs; but whenever it may be needed, increased accommodation may speedily be provided. The area is divided into four nearly equal portions by two broad avenues, crossing each other at the centre, at which point, surrounding the clock-tower, are offices for bankers and others, designated "Bank Buildings." The cattle occupy the eastern sections; the sheep, calves, and pigs are placed in the western. The cattle and sheep pens are conveniently arranged in relation to access and to supply of water; while covered sheds, alongside of which butchers' carts can be drawn up, are provided for the calves and pigs. Everything that can conduce to the convenience of buyers and sellers, and to the lessening of suffering to the animals, seems to have been thought of by Mr Bunning, the City architect.—(P. 262.)

In the immediate vicinity of the market are large hotels and taverns, lairs or covered sheds for cattle, public and private slaughter-houses, and everything tending to facilitate business—the whole worthy of the metropolis, and forming a striking contrast to the limited space and imperfect accommodations of Smith-

field. The ceremony of inauguration took place on 13th June 1855, under the auspices of Prince Albert, and the market is now in full operation.

Our space will not permit us to enter at much farther length into the consideration of other branches of the food-trade of London, of interest to the agriculturist, although the present volume supplies us with ample materials. The milk of London is proverbial for its tenuity, but the supply is not scanty, being aided from an inexhaustible source, "the cow with the iron tail;" a breed of milkers not peculiar to London, although most in demand there. Estimates have been made of the quantity of milk used in the United Kingdom, which may well astonish by their vastness, amounting in some cases to 1150 million quarts annually. Assuming that milch cows yield 7 quarts as a daily average, and that the retail price is 3d. per quart, 450,000 cows would be required to meet the demand, and the retail value would amount to the enormous sum of £14,000,000 per annum. The dairy cows of London yield a larger quantity of milk than the above-mentioned average—at least 9 quarts daily—and the number is about 24,000; it follows that the quantity of milk consumed is about 80 millions of quarts annually, which will amount in value to £1,600,000. But on this, as on nearly all the points relating to London food, authorities differ. Another computer thinks that there are 20,000 cows in and around London, and that they yield 12 quarts per day each. In 1840, Mr Youatt supposed that there were not above 12,000 cows thus employed, and that they supplied in a year 38 million quarts, for which the public paid £800,000. In a dairy near Peckham, containing 300 cows, the average yield of each is as high as 15 quarts; one cow in particular is specified, which yielded 28 quarts per day for six weeks.

Scrupulous cleanliness is everywhere maintained; the men engaged with the cows frequently bathe, and change their clothes. The milk, when drawn, is strained, and poured into upright cans; these cans are sealed, put into vans, started off at 3 o'clock in the morning, and arrive at a depot in the City; the seals are removed by a clerk, the milk is poured into other cans, and these cans, being locked by the clerk, are carried off by the milkmen who supply the breakfast-tables of the various customers. All this scruple is manifested in order to insure that which is somewhat rare in the metropolis—pure milk.—(P. 298.)

Every year the railways are bringing more and more milk to London, and it is evident that the trade is a profitable one. It is brought in cans holding from 6 to 18 gallons each; the companies usually charge at the rate of three farthings per gallon for carriage if the distance be within 40 miles, and one penny if for a longer distance—returning the empty cans free of charge. This milk is sold to large dealers at 5d. to 7d. per gallon; they dispose of it to

retailers at 7d. to 9d., who sell it in their turn at 3d. to 4d. per quart. It is estimated that in 1853 the quantity brought by railway exceeded 3,000,000 quarts. Not only will this commodity be cheapened by these means, but the temptation to adulterate it will be diminished. It is probable, indeed, that adulteration is chiefly confined to the milk sold in the poorer districts of the metropolis. The *Lancet* commissioners examined 26 samples from different dairies, and found 12 of them to be genuine; 2 had the cream removed, and the rest were mixed with water to an extent varying from 10 to 50 per cent. Butter is adulterated in a similar way. Of 48 samples examined by the parties just named, nearly one-fifth of the whole weight consisted of salt and water, the water having been stirred up with the butter, rendered semifluid by heating to increase the weight. Potato flour is sometimes mixed with it.

The poultry mania in England owes its existence chiefly to amateurs, to whom fine-looking birds, distinguished by certain conventional properties, are the chief object; but others have taken part in it with the praiseworthy desire of improving this branch of rural economy. It is one of the few in which we are greatly surpassed by the French; their fowls are plumper, more delicate, and at the same time cheaper than ours. We should be well pleased to see an accurate account of the manner in which they are reared, the nature of the food, &c. France is indeed pre-eminently a poultry country; the small proprietor-farmers find it a branch of industry well adapted to their limited means. The egg-produce of France has been estimated so high as 7000 to 8000 millions annually—an amount so enormous that if the eggs were strung together, like the egg-beads often made by boys in this country, the chain would coil twice round the globe! A large number are brought over from France to this country. The supply from foreign countries altogether is about 130 millions. Ireland produces 500 millions, Great Britain 900; so that 1530 millions annually may be regarded as our rate of consumption. At the rate of a half-penny each, we have thus an expenditure of upwards of £3,000,000 annually on this apparently trifling article. It is impossible to say with any degree of precision what proportion of this is to be ascribed to London. Neither are we in a condition to mention the amount of contributions from Scotland to the London mart; but it is worth while to notice the singular plan by which eggs used to be transmitted thither from Dumfries before railway conveyance was known.

Wholesale egg-merchants purchased at the market in that town, and conveyed the eggs to Carlisle by a species of land-carriage requiring skilful packing. A layer of straw was placed in the bottom of a cart, and on this a layer of eggs, so closely wedged together as to leave no openings but such as necessarily resulted from the shape of the eggs. This done, another stratum of

straw and another layer of eggs succeeded; and so on, until the body of the cart was filled. It is said that a mass thus packed is so firm that a load of meal might be placed on the eggs without breaking them. When the eggs had been brought to Carlisle thus packed in carts, they were sold to other dealers, who conveyed them along the Newcastle and Carlisle Railway to Newcastle; from Newcastle they were shipped to the metropolis by steamers. This system has necessarily undergone modification consequent on railway extension.—(P. 318.)

We cannot follow our author into his review of the corn-trade of Britain, or even into the comparatively restricted, though still extensive subject, the daily bread of London. Now that "good wheaten bread" is regarded as one of the indispensable requisites of life, even by the humblest artisan, it is obvious that the consumption of wheat in the metropolis must be very great. But we have to lament here, as in almost every other instance, the want of precise information, the paucity of statistical facts in which any degree of confidence can be placed. It it certainly surprising that we should have been so long indifferent to this subject; that we should be left to grope in the dark where we might have had abundant light; that, in regard to matters of the most vital importance to the community, we can so seldom affirm of a single circumstance, "This is true." It is well, however, to know our defects, of which we now seem to be conscious; and it is to be hoped that the example about to be set in regard to the principal features of agricultural statistics, will lead to corresponding measures in many subordinate, though by no means unimportant, branches of knowledge. Without further remark on this subject at present, we take leave of Mr Dodd's interesting and useful work with the following extract regarding the London corn-trade:—

Let the corn arrive in London how it may, nearly all the sales are effected in the Corn Exchange. This great mart of commerce is worth a visit, even on the part of those who have no immediate interest in the dealings; for it illustrates a definite mode of conducting important departments of commerce. Externally, the Corn Exchange presents certain Ionic pretensions, in its six columns, its cornice, and its entablature. Within, it presents to view a large open hall, lighted by a lantern over the centre; around the hall are stands or counters belonging to corn-factors, corn-merchants, millers, granary-keepers, and lightermen; but the chief owners or renters are corn-factors, who act as agents or middlemen between buyers and sellers. The sellers are mostly farmers who have home produce to sell, and merchants who have received shiploads of corn from abroad; the purchasers are chiefly millers, who buy the corn to grind it into meal or flour, and dealers or speculators, who buy to sell again at a profit.

A busy scene it presents on Mondays, Wednesdays, and Fridays, when the corn-market is held. Farmers, millers, merchants, shippers, speculators, granary-keepers, lightermen, factors—all are to be met there; but principally factors, millers, and speculators. About and within the area of the

hall, on any market-day between ten o'clock and three, we may see from eighty to a hundred stands, with perhaps eighty to a hundred groups around them. Most of these stands are decked with small wooden bowls and canvass bags containing samples of the corn to be sold. The factor has a desk, at which he rapidly transacts the book-entries arising out of the day's dealings. There is the most unquestioned and unquestioning faith in the probity of the factors in this respect, that the bulk of each purchase will correspond in quality with the sample: the very existence of the factorage system depends on scrupulous honesty in this particular. As to the bargaining, it is the same here as elsewhere; the chaffering about price speedily comes to an end between two men who pretty well know that, even if so inclined, they could not easily overreach each other. The purchaser generally gives the factor a bill at one or two months' date in payment of the corn; and the factor accounts for the proceeds to the seller, receiving a commission for his trouble. The sweepings, after each day's market, constitute a nice little perquisite; many a London chanticleer gets his dinner therefrom.

Driblets, mere driblets of corn, are seen at Mark Lane. A stranger might wonder wherein could be the mighty dealings of such a place, seeing that only a few score of small sample-bags are exhibited. But herein is one of the peculiarities of the factor or salesman system: the salesman need not encumber himself or his stall with the actual corn to be sold; he requires only a sample; the bulk may be in a ship, or in a dock, or, more likely than either, in a granary.

The granaries of the metropolis are necessarily very large, and the scene of important commercial operations. The owner of a granary may or may not be the owner of any of the corn stored therein. The granary system is distinct from the actual purchase and sale of the corn; for it is, in fact, a warehousing of the corn until required to be sold. The granaries are structures six or seven stories in height; some will contain only two or three thousand quarters of corn, while others have a capacity for eight or ten thousand. Along both banks of the Thames, from Greenwich in the east to Vauxhall in the west, these granaries are to be met with, but most numerous about the neighbourhood of Bermondsey and Shad Thames. While threading a path through this strange district, amid stores of horns, hides, skins, guano, barrelled provisions, sea-biscuits, and multitudes of other products of home or foreign origin, we cannot fail to notice the granaries, which predominate in height over the other buildings. Since the repeal of the Corn-laws, and the consequent free admission of corn from all parts of the world, this Bermondsey district has acquired a vastly increased amount of trade. The granaries and steam-flour mills have extended on every side. When the ships bring their loads of corn, the granaries are resorted to as safe warehouses, where it can be stored until required for sale or grinding. The granary-keeper tends, and turns, and screens the corn; and for this service, together with the granary-rent and insurance, the owner of the corn pays something under a penny a-week for each quarter.—(P. 173.)

THE FARMERS' NOTE-BOOK.—NO. LII.

Ploughs and Ploughing-Matches.—At the monthly meeting of the Highland Society, held in February last, the Plough became the subject of discussion, in an attempt to answer the question, "Is the Plough, as at present constructed, now the best form of cultivator?" It was evident, from the turn the discussion took, that the principal object of the speakers was to elicit opinions as to the comparative merits of the swing on Scotch, and the wheels on English ploughs. From the award of the premium at the Berwick Show to Howard's English plough, public attention in Scotland has been directed to its peculiar construction, and improvers of the plough have tried to ingraft some of its peculiarities (which, in fact, are those of English ploughs generally) on our ordinary Scotch ploughs. Thus we have heard lately of patents for wheels to be attached to our ploughs, and for mould-boards of almost every curve; most of them agreeing, however, in one particular,—viz., a greater length than is to be found in our Scotch mould-boards generally.

The implement-maker in Scotland who appears to have first imitated the English ploughs in their length of mould-board was Ponton, the success of whose ploughs, both at the exhibitions of the Highland and of local societies, and the favour which it gained from farmers in different districts, induced others to model their mould-boards after the same pattern. The tendency, therefore, in Scotland, of late years, has been to lengthen the mould-boards. At the meeting of the Highland Society referred to above, there was considerable difference of opinion expressed as to the advantage of wheels to the plough. It is now generally admitted that wheels, when the soil and weather are dry, render the draught of the plough much less, and are a decided benefit in enabling inexperienced ploughmen, and even boys, to hold and guide the plough with ease. Another advantage they possess, is in causing a furrow of equal depth and width to be turned over throughout the field, quite irrespective of the skill of the person holding the plough. But, on the other hand, there are disadvantages attending their use; for we are told by those who have used them, that after the slightest shower the wheels become clogged, and the draught is thus materially increased.

Howard's and other English ploughs are constructed to turn up a square furrow and lay it over at an angle of 45°, so that the largest amount of soil is turned up and exposed to the air with the least power. To show that such is really the case in practice, we subjoin the following table, constructed from experiments made on different ploughs at a ploughing-match:—

Number.	Depth of Furrow.		Width of Furrow.	Power.	Soil turned.	Soil turned to 1 cwt. of power.
	Land side.	Off side.				
	Inches.	Inches.	Inches.	Cwt.	Sq. inches.	Inches.
1	$6\frac{1}{2}$	5	8	$4\frac{1}{4}$	46	$10\frac{14}{17}$
2	6	5	$7\frac{3}{4}$	$4\frac{1}{4}$	$42\frac{3}{4}$	$10\frac{12}{17}$
3	6	5	$7\frac{1}{2}$	$3\frac{1}{4}$	$41\frac{1}{4}$	$12\frac{9}{13}$
4	6	$4\frac{1}{2}$	8	$5\frac{1}{4}$	42	8
5	6	$4\frac{1}{2}$	8	$3\frac{3}{4}$	42	$11\frac{1}{5}$
6	6	5	8	$4\frac{1}{4}$	44	$10\frac{6}{17}$
7	$6\frac{1}{2}$	5	8	4	46	$11\frac{1}{2}$
8	6	5	8	$5\frac{1}{4}$	44	$8\frac{8}{21}$
9	$6\frac{1}{4}$	5	8	4	45	$11\frac{1}{4}$
10	$6\frac{1}{4}$	5	8	$3\frac{3}{4}$	45	12
English.	6	6	9	4	54	$13\frac{1}{2}$

The first six were in the same field, the last five were in an adjoining one. A slight glance at the table will show that in soils of the same description, and furrows of the same size, there is a great difference in the expenditure of power, arising either from the want of experience in the ploughman, or from the irons not being properly set. Cast-metal socks are generally made for the English ploughs, of such a form as to cut a square furrow. However well these might answer in soils free from land-fast stones, they are perfectly useless in most parts of Scotland where these stones abound, in which case an ordinary sock must be used. A great objection found to English ploughs is the number of joints and complicated machinery which are about them. These are found necessary for the adjusting of the different parts; and besides the difficulty the men find in the use of them, they are very apt to be put out of order.

At the meeting of the Society referred to above, Mr Scott, Craiglockhart, made some most judicious remarks regarding ploughing-matches. He said that the work executed by the men who carried off the medals at these matches, though suited for some of the poor undrained ground in the upland districts, was about the worst that could be devised for an improved system of cultivation. He did not propose to do away with ploughing-matches, but suggested that medals should be awarded to the makers of ploughs (in addition to those awarded to the men) which are best adapted to perform a specified description of work. We have long held the same opinion regarding ploughing-matches. We consider that the kind of ploughing encouraged at them, however well it might have suited many of the soils in Scotland in their unimproved state, and thus been profitable to the farmer, cannot now be commended for an improved system of agriculture. We do not wish to see them done away, as we consider that they are an opportunity offered for a wholesome rivalry among our ploughmen, if their exertions were only properly directed, as suggested by Mr Scott. Under pre-

sent circumstances, in engaging a servant, we consider it no recommendation to be told of him that he has gained a premium or premiums at ploughing-matches.

We were surprised that not the slightest allusion was made at the meeting to any of the ploughs improved by the Marquess of Tweeddale. While all the speakers indicated the kind of ploughing that is desiderated at the present time—while some complained that the two-horse ploughs mentioned by them could not turn over a furrow 10 inches deep without oppression to the horses (a complaint, we may mention, joined in by most farmers)—not one in the meeting gave the least hint (though we are sure that there were many present who were aware of it) that there was really such a plough in existence as would answer the purpose for which they wanted it—viz., the "Yester Plough," which, with its companions, has produced such marvellous results on the farm after which it is named. We are not going to enter into the merits of these ploughs at present; this has been already well done by Mr Stephens in his small work on "Yester Deep Land-Culture." We only wish to direct attention to the subject, as it did appear to us unaccountable that not the slightest allusion should have been made to the subject at the meeting referred to: for we have no hesitation in stating, that there are no farm implements in existence which give the soil such a thorough stirring, at so little expense of labour and money, as the ploughs of the Marquess of Tweeddale.

The Tweeddale plough will turn over a square furrow of *hard* land to the depth of 15 inches with four horses, with as much ease to them as in ordinary ploughing. And where the land has been deep-ploughed and subsoil-trench-ploughed, the same plough can turn over a furrow 15 inches deep with two horses. And any one might have seen it drawn with ease by two horses last autumn on the Marquess's farm, ploughing up the potato land 14 inches deep for wheat. For the astonishing results obtained by the deep land-culture at Yester, we have only to refer our readers to Mr Stephens' work.

We have the greater confidence in recommending these ploughs of the Marquess of Tweeddale, as they are a solution of the problem —"Wanted an implement or implements which shall stir the soil, mix thoroughly the upper and lower layers, turn it over and expose it in the best form to the ameliorating influence of the atmosphere." Nor, in his attempts to solve this problem, did his Lordship allow himself to be led away by any preconceived notions of his own, as to what is termed fine or beautiful ploughing. He aimed at perfection in ploughing, as all practical men agreed that the particulars detailed in the above problem came as near perfection as was wanted. Guided by his own common sense and sagacity, he adopted that as his rule; and by careful observation and numerous experiments, he has succeeded in bringing his ploughs to their

present state of perfection. What he found wrong in the forenoon, we are told, he corrected in the afternoon. Thus are we indebted to the Marquess of Tweeddale for implements which enable us to perform that kind of ploughing best adapted for an improved system of agriculture.

There is one thing remarkable about the mould-board of the Tweeddale plough, which is worthy of being mentioned here. If two of these mould-boards are put together, their perpendicular section gives an exact representation of the perpendicular section of the hull of the new Thetis frigate. This coincidence was pointed out to the Marquess by his late brother, Lord John Hay, one of the Lords of the Admiralty. The Thetis frigate, it may be remembered, was built with a view to speed, and was distinguished for her fast sailing. She was exchanged for a couple of gun-boats which belonged to the Prussian government. No doubt her sailing powers depended on less resistance being offered to the waves; so the Tweeddale plough, from its mould-board offering less resistance to the soil, requires less power than any other plough to turn over the same quantity of soil. Thus does this curious coincidence show in a stronger light the truth of that beautiful metaphor expressed in the words, "she ploughs the deep."

On the Exclusive Use of Guano.—From the very favourable results obtained from the use of guano and other portable manures, and the high price of grain at present, some gentlemen have adopted a system of farming which, however profitable it may be in the mean time, is sure to be attended ultimately with the deterioration of their soil. There are to be found in particular districts proprietors, who, ignorant of the details of farming, and unwilling to give that attentive oversight so necessary to its successful prosecution, have thought it better to keep no animals of any kind on their farms. White crops only are grown, the tillage of the land is done by contract, a liberal dose of guano is sown with the crop, and the whole is rouped off standing. For the last two years this has paid well. The practice has been followed principally in districts where there is a demand for straw, from the number of dairies established unconnected with any farms; and where the soil is unsuited for the growth of green crops, two white crops are raised with a liberal allowance of guano, and then the field is sown out with grass, which is let to the dairy-keepers or graziers. Of course such a system could only be pursued where there is a demand for the straw.

As guano and other portable manures have really some most extravagant admirers, whom no arguments will convince, we will not attempt the task of proving to them the injuriousness of the practice referred to above, but will simply direct their attention to the effects of the exclusive use of guano when continued for a

time. We are told by M. Villeroy, in the *Journal d'Agriculture Pratique*, that there are farms in Saxony on which there are no animals, and on which the labour even is hired, and no manure but guano used. This has been continued for more than ten years; but it is found that they are now under the necessity of increasing the quantity of guano on those farms where it has been used exclusively. Where, for instance, they employed about 3 cwt. per acre, they are now obliged to apply about 4½ cwt. to produce the same results. He also mentions that there is an impression among the farmers in Saxony that guano is unsuitable for the growth of clover.

The above fact is deserving of all attention from farmers, particularly those who may pursue the system to which we have alluded before. It is also found here that much larger doses of guano are now required to produce results equal to those obtained when guano was first introduced into this country. This may no doubt arise from the guano now used being of inferior quality; but we do not think that there is such a difference in the quality as to cause such a disparity in the results. The true place of guano is as an auxiliary, not as a substitute for the ordinary manure of the farm. And it would be a pity if this, one of the principal aids to fertility, were to suffer at all in the estimation of farmers by its injudicious use.

The Mixing of Salt with Liquid Manure.—In a former Number of the Journal we directed attention to an experiment of M. Barral, by which he proved most satisfactorily that common salt was a fixer of ammonia. We have also more than once alluded to the important place it is yet likely to occupy among the saline substances used by the farmer. In Switzerland it is now almost the universal practice to mix it with liquid manure. Its value here is supposed to be derived from its property of fixing ammonia; and the discovery of the benefit which is derived from mixing it with liquid manure was quite accidental, and deserves to be mentioned in this place. The import duty on salt in Switzerland is very high and oppressive—so much so, as in all such cases to lead to many attempts of evading the vigilance of the custom-house officers. A peasant having tried to defraud the authorities by carrying off a bag of salt, was discovered and pursued. In his anxiety to escape the punishment which would be inflicted on him if the bag were discovered about his premises, he threw it into his liquid-manure tank, where he was sure there would be little chance of their searching for it, or at all events discovering it.

Thinking that he had destroyed his liquid manure, before using it he diluted it with water, so as to diminish as much as possible the bad effects which he thought would be derived from the salt. Great, however, was his surprise, when he found that the grass on

that part of the meadow watered with the liquid manure in which the salt was dissolved, was both more luxuriant in its growth, and was preferred by the cattle to all other forage. On perceiving this, the experiment was repeated with the same result. Government, also, having become aware of it, allows unpurified salt to be sold at a cheaper rate as manure salt. This is generally the refuse of the salt-works, containing from 75 to 80 per cent of salt. About $1\frac{1}{10}$ lb. of salt is used for every 22 gallons of liquid manure; in gravelly dry soils a larger proportion of salt is employed, and in soils naturally damp a smaller proportion.

In soils liable to suffer from drought, on dry hill-sides, salt is employed, after being first mixed with earth. Its effects are most apparent on pease and leguminous plants of every kind, on roots, potatoes, carrots, and ruta-bagas. It has little effect on clay soils, excepting when drained. In some districts it is used for improving the quality of the dung. The salt is first mixed with earth, and this mixture is spread on every layer of dung. These details on the use of salt, communicated by M. Fellenberg, are worthy of a careful consideration from farmers of all countries. We do not say that the application of salt directly to soils in this country will be always attended with as beneficial results as in Switzerland; but we cannot help expressing our opinion, that the value of salt as an ingredient in a compost-heap is not sufficiently appreciated in this country. And the practice, alluded to by M. Fellenberg, of mixing salt with earth, and then working this up with the manure of the farm, agrees so well with our own experience that we have no hesitation in recommending it.

Land-Draining. By JOHN TOWERS.—A system of drainage adequately carried out, if also founded upon sound principles, would prove to be one of the greatest and most enduring blessings that could be conferred upon agriculture, and the public consumers of its productions. The writer, therefore, feels it a duty to offer the following suggestions, having been convinced by repeated inspections, extended over a great breadth of country in East Surrey, that although there are some large farms and extensive estates in which vast improvements have been, and continue to be, effected by drainage, they yet must be considered as exceptions only to a rule which ought to be paramount. The writer repudiates the idea of being severely critical, as he is aware of the great outlay which must attend the carrying out of the required operations; but when, in each extensive walk, he rarely fails to detect proof positive that something of great importance has either been overlooked or neglected, and which is required to develop the full prolificity of agricultural land, he cannot refrain from laying before the readers of this Journal some of those glaring results which could only have so originated.

Now, in East Surrey there are thousands of acres which are surcharged with water. Thus, for instance, that very extensive waste called Mitcham Common is little better than a waste swamp, impassable in a wet season, and in its best state producing furze bushes, and a miserable turf here and there, scarcely fit to sustain a few sheep. The earth of this common—known by the term *Mitcham loam*—is proverbially excellent in horticulture, eagerly sought for, and sold to gardeners at a high price. The surface produces excellent sphagnum or bog-moss, a plant of great utility in the cultivation of foreign orchids. Were its hundreds of acres thoroughly drained and deeply cultivated, the quantities of cereal grains and other crops produced would be enormous. In its immediate vicinity are the villages of Merton and Marden, the subsoils of which are also soaked with water at no considerable depth, all of which could be floated off into one or other of the rapid streamlets of the Wandle, which small river discharges itself into the Thames. In the lands to the north and east of Croydon, the soil becomes of a stiff and binding quality, in which the writer has frequently seen water standing in the shallow furrows of corn-fields, with a thin scale of ice over its surface, during the partial frosts of the late winter. This state ought not to exist; nor will the agriculture of Britain arrive at its attainable point of productiveness until it be entirely obviated. It has been proved that, in order to produce bread-corn in the greatest perfection, it must be deemed essential to adopt a much deeper tillage, or, in other words, first to thoroughly incorporate the surface and subsoils to the full depth of 20 inches; and then, secondly, to lay the drain 12 inches deeper.

An experiment upon a vast scale, so conducted, has produced the finest crops of every variety, and with less manure than is usually supplied by those farmers who are content with the scratchings of the surface made by ordinary ploughs with their heavy compressing soles. It is perhaps a matter of indifference whether the above thorough pulverisation and incorporation of soils be effected by the steam *cultivator* described by *Talpa*, or by the two instruments invented by the Marquess of Tweeddale—the object to be kept in sight is, the marvellous effects that would be produced and maintained for years. And now, in order to close the subject by an appeal to observable facts, the writer further suggests that the ditches which commonly serve as bounds to fields and roadways might be made to subserve as guides or gauges for the discovery of the position of stagnant water in the adjoining lands. If, instead of 12 or 14 inches, the ditches were dug to the depth of 2 feet or 30 inches, and made with a true and gradual fall at the bottom, the inlet and flow of water would exhibit pretty accurately the position and depth wherein the drain-tiles ought to be laid to secure an effective outfall. If stagnant and

fermenting water stand in the shallow ditch of 12 to 15 inches depth, it may be concluded as certain that the land is either undrained, or, if drained, very inadequately so. On the contrary, upon some properties not remote from Croydon and Norwood, there are ditches dug a yard deep, wherein *clear* water flows freely, and delivers itself into some water-course. Here, and in similar cases, the existence of drainage is established, though the system pursued might not have been entirely adequate. In one instance, where several acres of land have recently been purchased by a farmer, personally known, the adjoining ditches have been so excavated as to leave no doubt of their perfect efficiency. The water is there conveyed into the main course from the lands adjoining, and flow at the depth of 4 feet, in a state of complete purity, supplying in its course a small pond, useful in the farm, and also where sheep could be washed prior to shearing. Such examples of foresight and energy are well worthy of imitation.

The Farmer's Rain-gauge. By JOHN TOWERS.—Allusion to an instrument by which the volume of rain that may fall in any particular locality may be measured is constantly made by writers of meteorological reports. Monthly notices on this subject recur in the article on "The Characteristics of the Year;" but as I have been taught by observation that little dependence can be placed upon registers of any phenomena taken in various places, though even not widely remote, I was led to construct an instrument by which any party might obtain a pretty accurate local knowledge of the quantity of rain that had fallen, day or night, within a certain period of time. To such an instrument (the cost of which may be under five shillings) I have given the above appropriate title—"The Farmer's Rain-gauge."

In constructing the instrument, I took for a standard the cubic inch of distilled or clear rain-water, the weight at 60°, being 252½ grains. This filled to the neck an accurately-weighed ounce phial. The level of the water was marked on the glass by a sharp file, as were also the ¼th, ½, and ¾ths of an inch. These volumes are represented decimally by the fractions .25, .5, and .75. The reader who is desirous to construct a gauge in order to try conclusions for himself, is recommended to commence by constructing such a measure, by which a bottle to receive the falling rain may be graduated upwards from 1 to 60 or more cubic inches, according to its capacity. The one I now use contains about 36 fluid ounces; but I would prefer a "Corbyn's" quart in localities where rain generally falls in considerable quantities. The medical glasses of pharmaceutical chemists, graduated from one drachm to four ounces, might be used, because the half-ounce or four-drachm measure is found to contain, at ordinary temperatures, one cubic inch, less a few drops only. The vessels being ready, a square funnel, made with the utmost accuracy, will complete the

instrument. Persons in general make use of a round funnel; but, to say nothing of the impossibility of "squaring a circle," so much inaccuracy was detected in its products that I was constrained to adopt the square form. The one I employ measures exactly 8 inches across its rim, and consequently exposes 64 square inches to the falling rain. It is made of tin; but *zinc* is to be preferred, because that metal requires no paint, and is not liable to decomposition or rust.

In fixing the gauge, the bottle should be sunk nearly to the level of the ground, because it is self-evident that rain falls upon the surface; and in order to obviate inconvenience, and to secure the glass, a large garden-pot is sunk to its rim, and the bottle is placed therein, and then surrounded by soft moist sand, a coating which protects the glass and keeps it steady. The situation of a rain-gauge is a consideration of no little moment. Many persons would be apt to imagine that the higher it was placed the more truthful would be its report. The fact appears to be directly the reverse, as perhaps will be made to appear by the following nearly literal passages from Dr Charles Hutton's *Mathematical Dictionary*, vol. ii. p. 279:—

"It is found that more rain is collected the nearer the gauge is placed to the ground. In one place a funnel was placed above the highest chimney, and another on the ground of the garden belonging to the same house, and the same difference was found between two others which there had been between them, when placed at corresponding heights in different parts of the town. After these facts had been sufficiently ascertained, it was thought proper to station a rain-gauge at a much greater height—upon the square part of the roof of Westminster Abbey. Here the quantity was observed for a twelvemonth, the rain being measured at the end of every month, with a corresponding result. Great precautions were taken to prevent loss or evaporation."

Comparisons also were obtained by placing a gauge on the top of a house, and another below the top. Three tables are added, stating the results per month of each, and also those of the entire year: whence it appears that, in the year 1766, there had fallen below the top of a house, 22.608 inches; upon the top, 18.139 inches; and upon the Abbey top, 12.099 inches. This experiment was repeated in other places with the same results."

In order to avoid perplexing our readers with the various attempts that have been made to explain the causes of such results, I would solicit their attention to the following queries. Do not clouds consist of an infinite number of watery or vapour atoms? Are they not in an electrical condition, which renders them repulsive of one another, till they become disturbed by the earth's surface, then brought into an opposite condition by the agency of induction? At all events, prior to change of weather these vapours are seen to coalesce, enlarge, and frequently become visible in the

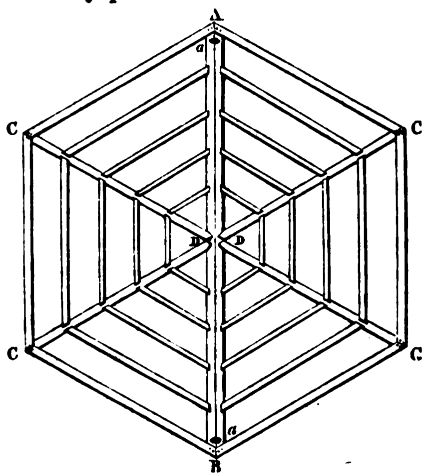
form of dark or black rays approaching the earth. Attraction and condensation going on simultaneously, the *nimbus* or rain-cloud forms, a shower falls, or perhaps a close and continuous rain is established. Electricity is the great agent, and it acts by induction; but in the vast laboratory of nature its operations are conducted upon a scale too grand to admit of complete elucidation.

Stack-Stathels.—We have often been astonished in travelling through the country at the carelessness and untidiness which are displayed about the stack-yards. They are usually unenclosed, and, even though situated at the side of a public road, left quite open to the ravages of beasts—yea, made to appear most inviting to the homeless vagrant from the quantity of loose straw lying about, who is generally not slow to avail himself of the comfortable bed thus offered him. Having taken up his position, his match is struck, his pipe lighted, and the remainder of the match thrown carelessly from him. No wonder that next morning some stacks are found to be on fire; and the most different suspicions are expressed as to the cause of the fire. Too often incendiarism is blamed for what would have been prevented had the farmer's property been better protected. And we consider this protection as much a landlord's duty as a tenant's.

But that tenants do not take that care of their own property which they ought to do, is evident from the few stathels, or rick-stands, which are to be found in our stack-yards. Those stacks which are intended to be kept over to the spring and summer months, should always be placed on stathels. Those who have never possessed these useful articles can have little idea of the great saving of labour and trouble which they cause in harvest, and the immense advantage they are of, in preserving the grain from wetness and vermin. In a stack-yard where there were no stathels, it was customary to keep six or eight wheat-stacks during the summer, to be threshed off immediately before harvest. It was almost impossible to calculate the loss from vermin when the grain was laid on the barn-floor. To satisfy the curiosity of the farmer one season, the stacks were surrounded by boys when they were being removed to the barn, so that as few rats and mice as possible might escape. The result was that each stack was found to contain from 300 to 700 mice, besides a dozen rats. The grain was almost unsaleable, not only from being broken by the vermin, but particularly from the quantity of dirt which it contained, and the disagreeable mossy odour which it had. All stacks to be kept over to summer in that stack-yard are now placed on stathels; and the appearance of a rat or mouse in any one of them, when threshed, is an exception. To test, however, the benefit of good stands for several seasons, a stack built on the ground has been left standing during the summer, beside one on a stathel, and then both were threshed on the same day, due pre-

cautions being taken that the vermin of any would not escape from the first threshed to its neighbour. It has invariably been found that, while the mice were numerous enough in the stack built on the ground, there was scarcely one to be found in the other. One great advantage of stathels is, that even though vermin may get into the stacks, they offer a favourable opportunity to terriers and cats for watching for their prey, when it tries to make its escape from the stack for water, and thus its increase is prevented. This is particularly the case with rats; and though mice may exist much longer without water, and thus have less occasion to leave the stack, still there are times when, in showing themselves at the bottom of the stack, they are unexpectedly seized upon by their watchful enemy.

Many farmers object to the use of stathels from their great expense. It is true that those made entirely of iron are expensive, but not more so than can, in most cases, be repaid even the first year, where the stacks are kept till summer. But there are many cheaper kinds—those, for instance, made of stone pillars and wooden framework. A set of pillars of stone, wrought, can be got for from 6s. to 10s. in the districts where they are made, and the framework will vary from 15s. to 30s., according to the kind of wood of which it is made. Some object to the use of wood, from its speedy decay in being so much exposed during the summer months. We can only say that the farmer who exposes his stathels to the weather is himself to blame for their decay, for they are very easily protected by straw with very little trouble. But there are many who would prefer them made in a portable form, so that whenever the stacks are threshed they may be removed, and laid carefully past under cover. The best we have seen of this description is one constructed by J. S. Hepburn of Colquhalzie, Auchterarder, which has received honourable mention at some of the exhibitions of the Highland Society. By the kindness of Mr Hepburn we are enabled to publish the following description of it:—



"The portable hexagonal rick-frame is very simple, consisting of a pair of stretchers, AB, extending across its diameter, upon which the four half-diagonal bars C D are spliced by a level on the ends D, the outer ends of all the diagonals being

half-checked to receive the outer bars of the frame A C, B C, C C, which are half-checked to correspond. The interior bars are spliced upon the diagonals in a similar manner. A pair of hasps and staples *a, a,* securely bind the two halves of the frame together upon the pillars, and they are easily taken separate, and put under cover when not in use.

"My frames are made of small larch slit through the middle, the pair of main bars 10 feet long, 3½ inches broad, and 3¼ or 3⅜ thick; the outer bars 5 feet long, 6 inches broad, and 3 inches thick, the interior smaller."

Salt Spring of Nauheim.—The extent of country occupied by the cold and hot springs of central Germany possesses a very interesting geology, as well as an imperishable fame for the restoration and preservation of health to invalids. Yearly, thousands resort to those springs, to drink them and to bathe in them, for the cure of many complaints; and few leave them with disappointed minds. On the contrary, those who have visited them for that purpose are ever willing to return to their charming localities for recreation alone, freedom from care, and the real enjoyment of animal life. It would be a pleasing task to depict the attractions peculiar to the locality of each spring; but the subject would be too extensive and varied for such a cursory notice as this; so we propose to confine our observations to, perhaps, the most remarkable of them all—namely, the Salt Spring of Nauheim.

Geologically, the most famed of the salt springs of Germany, whether hot or cold, are situate in the new red sandstone formation, which, in the arrangements of modern geology, finds itself in the mesozoic group, secondary formation, and triassic system, which is the oldest of three periods comprehended in the secondary period. The beds immediately overlying the Zechstein or magnesian limestone on the continent of Europe, form themselves naturally into a tripartite group, to which the name of the "triassic system" has been applied. The system consists of three groups—the Bunter sandstein (variegated sandstone), the Muschelkalk (mussel-chalk), and the Keuper (variegated marls). (1.) The variegated sandstone is in three states, having sometimes a white colour, but more frequently red, blue, or green. The lower portion is a fine-grained solid sandstone, sufficiently compact to form a good building-stone. The upper strata are incoherent, and pass into an earthy clay, containing gypsum. The intermediate portion is compact, but its structure is conglomerate, and it is used for making millstones. (2.) The mussel-chalk is a compact limestone, of a grey or greenish colour, and commonly contains, in great abundance, the remains of shells, and fragments of radiated animals and fishes. It lies conformably upon the variegated sandstone. It is in three states: the upper portion consists of com-

pact limestone bands; the intermediate, a yellowish coloured limestone, alternating with thin bands of gypsum, and contains a considerable quantity of rock-salt; and the lower portion is occasionally a bituminous rock, which emits a fetid disagreeable odour when rubbed. (3.) The variegated marls lie conformably upon the mussel-chalk. They consist of a numerous series of mottled marls, of red, greenish, grey or blue colour, passing into black slaty clays and fine-grained sandstones. Throughout this series, common rock-salt and gypsum are abundant, but the organic remains of animals are extremely rare. Of plants, a considerable number are preserved in some localities, and these indicate a wide departure from the flora of the carboniferous period.

This geological system occupies a considerable part of the surface of central Germany. It extends from Baden-Baden in a straight line on the west, by Darmstadt, Frankfurt, Hesse-Cassel, to the principality of Lippe; and on the east from Baden, in a curved line by Ellwangen, Bamberg, Meiningen, Merseburg, and Bernberg. This great surface is only broken in Darmstadt by trap, and in the Clausthal by the old red sandstone. It is traversed in a north-west direction by the mountain-range of the Taunus, the highest point of which, the Feldberg, reaches to the height of 2848 feet above the sea. This mountain-range divides the geological country under consideration into two great basins or plains, the one on the north being watered by the Lahn, and the other on the south by the Main. The plain from the Rhine to the foot of the Taunus mountain consists of a deep deposit of rich clay, mostly gravel, or gravel and sand. Its undulating surface is of the most pleasing description, and occupied by the most celebrated watering-places. It is embellished by the most varied foliage. Its general elevation is about 600 feet above the sea. From the summit of the Feldberg mountain—which may be very nearly reached in a carriage, and entirely on horseback—is displayed a magnificent panorama of the Bergasse on the one hand, and of the Lahn country on the other; in the former of which are perceived the towns of Homburg, Frankfurt, Darmstadt, Heidelberg, Mayence, Bingen, Wiesbaden, Soden, and numerous villages; and in the latter, Schweinfurt, Fulda, Marburg,—and rendered interesting by the ruined castles of Koenigstein, Falkenstein, Kronberg, Friedberg—and dense forests clothe the mountains, while a richly cultivated country is seen on the plains. The sunrise from the top of the Feldberg is only excelled in glory by that from the Rigiberg in Switzerland.

This new-red-sandstone group finds a counterpart in England. Wherever the magnesian limestone occurs in that country, its edges are seen covered up by an extensive series of a yellow and red arenaceous bed, alternating with red, green, or blue marls, which are rarely fossiliferous, and which often contain common rock-salt in

great abundance, associated with crystals of gypsum. This red sandy rock wants conformability with the formation of more ancient date on which it reposes. "It appears to have been deposited," says Mr Ansted, "over most of the rocks in the central part of England, long after they had been formed, and even after subterranean disturbances had tilted and displaced them; and it is easily recognised filling up the valleys and covering the plains, but rarely reaching to any great height, and for the most part very little disturbed from its original horizontality. Owing to the nature of the alternating marls and gypsum of the series of strata, the vegetable soil arising from its disintegration is extremely fertile; and in the greater part of Devonshire, in the valley of the Severn, and yet more strikingly in the agricultural districts of Warwickshire, Staffordshire, and Cheshire, many peculiarities may be observed characterising this formation." "It is in Cheshire," continues Mr Ansted, "the southern part of Lancashire, and the northern part of Shropshire, which together form an extensive and rich plain, watered by the Dee, the Mersey, and the Weaver, that the uppermost beds of the new red sandstone are chiefly developed; and by a minute examination of these beds and those of Warwickshire, the saliferous marls have been identified with the uppermost strata of the foreign Triassic system. The whole district abounds with salt springs, which are more especially plentiful in Cheshire; and in that county, also, there occur extensive masses of rock-salt in a solid state, their total thickness amounting to not less than sixty feet. . . . The whole of the upper new red sandstone, as exhibited in England, bears evident marks of its marine origin, even if the occurrence of so large a quantity of salt associated with it did not place the matter beyond a doubt."* The great distinguishing feature between this formation in Germany and England is, that in England—the great middle division—the mussel-chalk group is entirely awanting; and the new red sandstone is not conformable with the strata upon which it reposes.

Besides these countries, the new-red-sandstone formation is to be found in considerable extent in Europe, on the left of the Rhine, in Rhenish Bavaria, in France, in Switzerland, the Tyrol, Upper Austria, Gallicia, and Hungary.†

Common salt is found in nature in four states, from which it is manufactured for use; one, in large masses, named rock-salt. Rock-salt does not appear to possess any determinate elevation upon the surface. It is worked at Wieliczka, in Poland, at a depth of 860 feet beneath the surface, and the rock has not yet been bored through, though mined for many centuries; and at

* Ansted's *Geology*, vol. i. p. 288.
† See *Geological Map of Europe*, constructed by A. Keith Johnston.

Hallein, near Saltzburg, at an elevation of 3300 feet above the sea. This mineral is not deposited in a geological stratum, but rather in lenticular masses, of very variable extent and thickness, placed alongside of each other at equal distances, and interposed between the courses of the other formations.

Common salt also occurs intermixed with other rocks. Thus at Arbonne, in Savoy, the rock is a mass of saccharoid and anhydrous gypsum, imbued with common salt, which is extracted by lixiviation, after which the gypsum remains porous and light. This saline rock of Arbonne is at an elevation of 7200 feet above the sea, in the region of perpetual snow. Common salt is also obtained from salt springs. It has been noticed that salt springs issue in general from the upper portion of the saliferous strata, principally from the saline clay marls. Cases, however, occur where they are not accompanied by rock-salt, and where the whole saline matter is derived from the marls themselves, which thus constitute the only saliferous beds. The origin of salt springs is not difficult to be accounted for. When such saliferous beds lie conformably upon the strata of an adjacent mountain-range, the rain which descends from the upper part of the mountain finds its way by gravity towards the plain below, and, in descending, carries along with it as much of the salt, whether from the rock or saliferous beds, as it can dissolve, and its power of solution is as 2.82 to 1 of salt. But the greatest mine of salt is the ocean, of which it constitutes about one-thirtieth part of its weight, and is pretty evenly diffused through its waters. The specific gravity of sea-water is 1035; but a specimen examined by Dr Ure, from the Red Sea, was as high as 1043.

Had the saliferous solutions, thus brought down by the rain from the sides of the Taunus mountains to the plains on each side, been left undisturbed in their hidden subterranean strata, the most famed brunnens of Germany would have had comparatively no existence. The waters would have remained pent up in their dark and mineral casements, unknown and unused. The piercing of Artesian bores released them from their forced imprisonment, and, impelled by a force proportioned to the altitude of the head pressure, they have since poured forth, with an unintermittent stream, a precious health-restoring beverage, the sale of which has enriched the inhabitants of those plains with a wealth surpassing in value the fruits of their rich and cultivated soil. The bores were made from 130 to 700 feet in depth, and each has brought up to the surface, and even higher, waters varying considerably in composition and temperature. Chemical analysis has shown that these waters contain, as might have been expected from the geology of the strata from which they spring, chiefly salts of soda, and most commonly common salt, varying in quantity from 0.925 grains in a pint of water, as at Schwalbach, to 143 grains,

as at Hamburg. They also abound in carbonates; so that the quantity of carbonic acid in a pint of water held in solution, and set free after the head pressure of the spring had been released, varies as much as from 4.91 cubic inches at Kreutznach, to 48.64 cubic inches at Homburg. The temperature of the waters varies, in the hot springs, from 80° Fahr., at Schlangenbad, to 158° at Wiesbaden; and, in the cold springs, from 48° Fahr., at Kreutznach, 50° at Homburg, and from 59° to 75° at Soden.

On approaching Nauheim by the railway from Frankfort to Dresden, we look down upon it from the station, which is on a high embankment. The small town stands at the base of the Taunus mountains on a plain of rich ground, ornamented with trees. The most remarkable objects which at once arrest your attention are a number of long, high, dark-looking erections, of a very artificial and temporary appearance, standing parallel to each other. You cannot conjecture, and could never discover, what they are meant for, while you are certain they were never intended to ornament the neighbourhood of the town, for more unseemly objects can hardly be imagined. When informed that they are connected with the salt-works of the place, you still cannot comprehend how such uncouth things should be used in the making of salt or any other material. On descending the road from the station towards the town, a magnificent column of water soon comes into view, if it be playing to its height at the time. This water-work is confined within a square wooden sewer, the side of which to the road is open. This, in fact, is the salt-spring which supplies the brine from which the salt is manufactured here, and which alone renders the place attractive to strangers; for it certainly is a wonderful phenomenon. A spring of salt water, obtained by an Artesian bore, had long been used here for the manufacture of common salt, and it still plays immediately behind the column referred to, throwing up a small jet of 3 or 4 inches in diameter to the height of about 12 feet. It was suggested that a bed of rock-salt would be found in the strata below, and search was made for it by boring to the depth of 600 feet, when the attempt was given up as hopeless. Shortly afterwards a slight shock of earthquake disturbed the subjacent strata, and suddenly released a body of water, which, on rushing up the bore, elevated itself into a beautiful column of 18 inches in diameter, to the height of 50 feet, and has continued to do so ever since. The great force of such a column of water rushing upwards, causes the air to mix with it largely, and to furnish it with a top of white dense foam, rendering it into the similitude of the pistil of a gigantic flower, surmounted with a display of beautiful white pollen. The column does not play to its entire height at all times, being mostly kept down by means of an iron cover of a conical shape, from under which the water escapes in large iron pipes to the

odd-looking structures referred to. These structures are at a little distance from the column, in a large field, in parallel rows, at some distance from each other. There are six of them, each some hundred yards in length, from 30 to 40 feet in height, according to the slope of the ground upon which they stand, and in breadth about 35 feet at the base, tapering to about 18 feet at the top. They are composed of a framing of wood upon a basement of low stout pillars of masonry. The brine is pumped up, by means of steam, into a tower at the upper end of each structure. From the tower the brine flows along a trough of wood, placed horizontally upon the top of the framing, each side of the trough being pierced with small holes, into which are inserted short tubes, with small stop-cocks, for emptying the trough of brine by a succession of drops from the cocks. The brine falls drop by drop upon a thicket of thorn branches, laid in succession from the bottom to the top of the framing. In dropping through the deep thicket of thorns, the brine at length reaches the bottom, which is shaped in the form of a trough, along which it runs to the lower end, from which it is conveyed in large iron pipes under ground to the next structure, where the brine is again pumped into a tower, and subjected to the same process of filtration, until it has dropped through all the six structures; from the last of which it is conveyed in pipes to large reservoirs, where it remains ready for the boiling-house. The use of these structures is simply to expose the brine to the air, with a large surface, which it does in dropping from branch to branch of the thorns from a considerable height, through six successive filtrations, in order to get rid of as much water as possible by evaporation, before the tedious and expensive process of boiling is resorted to. Evaporation is most active in summer, from May to August, but the process is carried on for about two hundred and thirty days in the year. The evaporation is about 13 imperial gallons in twenty-four hours from every square foot of surface. The brine, as it comes from the jet, has a specific gravity of about 1010, which is low; and the filtration, or graduation, as it is called, raises it to 1140, thereby increasing the proportion of salt in it from 7½ to 22 per cent. In the course of the filtration the thorns become incrusted with gypsum, coloured buff with oxide of iron, and when they are much so, in the course of years, they are renewed with fresh thorns. The boiling-pans are shallow, and made of iron, and placed over furnaces. As the brine becomes stronger by evaporation in the pans, more graduated brine is added from the reservoirs until crystals of salt make their appearance, when the supply is stopped, and the panful boiled off. To render the salt purer, the brine is run off the first pan into a second, in which, as the crystals fall, they are gathered towards the side of the pan, and from thence are lifted, with cullender

shovels, into conical baskets of willow, of 4 feet in height. The baskets are then set upon their apex in a stove, in which the heat is kept up to 120° or 130° Fahr.; and when sufficiently dry, the salt is stored away in the warehouses.

The salt thus obtained is by no means pure, having only from 94 to 98 per cent of chloride of sodium. The chloride of magnesium or bittern deteriorates salt very much, imparting to it a bitter taste, and occasioning a considerable loss of weight. As a means of purification, in some places the strongest brine is poured over ropes, placed vertically, and when an incrustation of 2½ inches is effected, the crystals are broken off and gathered up. The purification may then reach as high as 99.45 per cent. The process of the ropes will do as much work in seventeen hours as five or six days of the pan, the salt being also purer, though at a sacrifice of quantity. At Catwyck, in Holland, the bittern is melted out by washing in water, while the salt is not affected.*

The uses of salt are well known; but still many may be surprised at the many ways in which it is used. "Besides its vast utility in seasoning food," says M'Culloch, "and preserving meat, both for domestic consumption and during the longest voyages, and in furnishing muriatic acid and soda, salt forms a glaze for coarse pottery, by being thrown into the oven where it is baked; it improves the whiteness and clearness of glass; it gives hardness to soap; in melting metals, it preserves their surface from calcination, by defending them from the air, and is employed with advantage in some assays; it is used as a mordant, and for improving certain colours; and enters more or less into many other processes of the arts. Many contradictory statements have been made as to the use of salt as a manure. Probably it may be advantageous in some situations, and not in others." †

Nauheim is a neat small town, containing a population of 1424. Its salt-spring is stated to produce 17,000 cwt. of salt annually. It has a *Cursaal*, with a garden and band of music, a *table-d'hôte*, a large reading-room, a good inn, and an establishment of baths for cold and hot bathing, for such invalids as a strong saline bath is suited to. It has some good shops, a large space for promenading, and in the immediate neighbourhood is a large beautiful lake, in which boating and angling may be enjoyed.

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* See Ure's *Dict. of the Arts*—SALT. † M'Culloch's *Commercial Dict.*—SALT.

REPORT BY A COMMITTEE OF THE SYNOD OF ANGUS AND MEARNS AS TO AGRICULTURAL LABOURERS.*

The committee appointed to investigate the condition of agricultural labourers within the bounds of this Synod, having circulated a series of queries, have now the satisfaction of reporting the valuable information which they have received in consequence of these queries having been replied to by all the parochial clergy.

In order that the Synod may more distinctly appreciate the importance of that class in society to which our investigation refers, we pray that it may be remembered that, according to the last census, there are within the counties of Forfar and Kincardine 7915 male and female outdoor agricultural labourers, and 5226 male and female indoor agricultural labourers. As domestic servants and shepherds are not included in this enumeration, it follows that within the bounds of the Synod there are 13,141 labourers engaged in agriculture: of these 10,160 are males, and 2981 females.

Their mere numbers afford a very imperfect idea of their importance as members of the community. To them is committed a vast amount of valuable property, the continued value of which is mainly dependent on their honesty, care, and kindness. If ignorant of the laws of animal health, or not conscientious in the discharge of their duties, how disastrous must be the result to the 12,158 horses, as well as to the 18,432 milch cows committed to their care. If unskilled or immoral, what an effect must ensue on the produce of the 650,790 acres, the tillage of which is performed by them. If they be not good and faithful servants, how great a source of discomfort and loss must they be to the 132 landed proprietors, and to the 3497 farmers within our bounds. If they be not God-fearing men and women, how deplorable their influence within each of our parishes.

To institute careful inquiry into their moral, educational, and physical condition, is thus manifestly the duty of the Church, and the interest of all. We rejoice that the Synod is now, after no small labour, in possession of much trustworthy information. Those portions of it which could be exhibited in a tabular form have been arranged by our convener in eleven tables,† appended to our Report, and calculated to be useful, we believe, by exhibiting

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* Though presented by a Committee of Synod, and generally approved of by the Synod, this Report must not be regarded as in every sentiment and expression sanctioned by the Synod. It is the production of the Committee's Convener, who alone is responsible for its publication.—D. E.

† Table 11th, referring to education and morals, is not here published. It will be printed, however, and sent to the clergy within the Synod.—D. E.

at a glance the moral and social condition of our parishes. Of this we give a single specimen.

Reading these tables continuously, we learn that in the parish of Brechin there are 197 men hired as farm-servants, 7 boys under 16 years of age, 20 female out-workers, 73 female domestic servants, 10 jobbing men on day's wages, 4 old men unfit for agricultural or jobbing labour; that of these classes 66 live in the houses of their masters, 86 in separate houses, 90 in bothies; and that the houses for their accommodation are too few, and not favourable to the preservation of health and decency.

The total numbers of the respective classes concerning which we have returns from 76 parishes and 2 *quoad sacra districts*,* are as follows: 6837 hired men, 1480 boys under 16, 1789 female out-workers, 2397 domestic servants, 1483 jobbing men on day's wages, 423 old men unfit for agricultural or jobbing labour.

In regard to the old men there is a mistake in the figures from the Presbytery of Dundee. They refer to old men "useful" instead of "unfit" for agricultural labour. Shepherds also are included in the figures relating to Lochlee. The conclusions drawn from the above numbers can be little affected by these misapprehensions of the objects of our inquiry, which relates exclusively to agricultural labourers, and female servants domiciled with farmers.

The first question suggested by these figures has a most important bearing on rural economy. Is there in the counties of Forfar and Kincardine an adequate supply of agricultural labourers? We think there are grounds for believing that for several years this has been verging towards a *minimum*, and that the increased diminution caused by emigration and war may soon result in serious public inconvenience. We point to this fact; we would remind landed proprietors and farmers that this district was lately visited by agents from Van Dieman's Land desirous of exporting thither agricultural labourers, and offering tempting inducements; and the exhortation we would address to our rural gentry and farmers is *this*, Instantly seek to arrest the further deportation of agricultural labourers by increasing their comforts, improving their dwellings, and evincing a more lively and Christian interest in all that affects their wellbeing.

We direct special attention to the fact of there being within the province only 423 old men unfit for agricultural or jobbing labour. From this shall we infer that agricultural toil is so exhausting to the human frame that few of those engaged in it see old age? or that, so soon as they attain to it, they are forced into the towns by those to whom they are no longer useful, but for whom, and often for slender remuneration, they have expended the very pith of their

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*** English readers may require to be informed that such districts are those assigned to Chapels of Ease, and separated from parishes only for ecclesiastical purposes.**

prime? The adoption of either alternative is painful, and suggests that somewhere there is grievous failure in Christian duty. How unnatural that state of society in which there are hardly any old men! And yet we find that, out of 76 parishes reported on, there are no less than 18 in which there is not a single old man fit for rural labour! We are persuaded that it is cruelly impolitic to drive aged men from their family hearths and accustomed haunts; on invincible grounds of Christian philanthropy we claim for them more kindly consideration; and being aware of a considerable and growing diminution in the number of houses for cottars, we declare our belief that the so-called policy of this procedure may be reasonably questioned, and that in many instances it is mere short-sighted selfishness. To be cruel is always wrong, and never can be permanently expedient.

This brings us to the consideration of the nature and amount of house and bothy accommodation for rural labourers.

In a very large proportion of our parishes the number of houses is insufficient. The minister of —— reports,* "There is an undoubted want of *healthful* houses for hired and jobbing labourers. In point of fact, there is a great lack of houses of *any kind* for our agricultural labourers."

Another of the brethren declares that in his parish "there is not a single unoccupied house; so that persons desirous to marry must migrate, unless lucky enough to secure the house of some one leaving the parish."

Of course, if there be not houses for their accommodation, the number of rural labourers must go on diminishing; and our farmers will become more and more dependent on the supply of labour from the towns in their vicinity. In short, the large-farm system, accompanied by the reduction of cottar houses and the abolition of small holdings, has been carried to an excess which is injuriously affecting our whole system of rural economy. When the policy of proprietors is to have few houses on their lands, they naturally become careless as to the proper conservation of what they have resolved to destroy.

This, undoubtedly, is one cause of the miserably defective accommodation for rural labourers. According to the report from the parish of ——, (and it is a fair sample of the state of matters in the great majority of our parishes), "the house of an agricultural labourer usually consists of two small apartments, with a dark niche between called a pantry. It is generally damp and unventilated (unless in those cases where the hand of time has made ghastly fissures), and unlathed. I do not believe that our agricultural labourers are less healthy, but, on the contrary, more so, than the

* The names of ministers and parishes were alluded to without reserve when this Report was read to the Synod, but are now left blank for obvious reasons.

mechanics of our large towns; but this, assuredly, is not to be attributed to the dwellings they inhabit, but to the more salubrious nature of their employments, and to their more sober habits."

To this we must add that we are in possession of evidence proving that many live in single rooms barely 6 feet high, the floor being of clay full of holes, the roof of rotten thatch, through which rain often pours, and the walls of stones, turf, or earth, pervious to every wind. To see, as we have often seen, a husband and wife, with several children, living in such a miserable crib is repugnant to every right notion of what is due to a human being; and we are indignant when contrasting it with the superior accommodation provided for cattle and horses.

In almost all our parishes there are some such shameful dwellings. One of the reporters gives some most painful details of the scenes witnessed in such houses when the inmates are assailed by lingering disease. Another exclaims, "Health and decency! Think of one apartment, which in many instances has only a clay floor, serving for parlour, kitchen, bed-room, nursery, and hospital!"

The bothy accommodation is often still more objectionable than that provided for the married labourer. As there are comfortable cottages, so are there, no doubt, comfortable bothies, but of these the number is notoriously small. The minister of —— has furnished us with a sketch of those in his parish, and with a fidelity which cannot be disputed.

"On entering, four bare walls, never plastered, present themselves. Casting the eye upwards, you can generally see the sky through the slates, if it be fair above, otherwise you may also feel its influences. Floor there is none. On the earth, where the floor should be, is most commonly a *hack-stock*, an axe, and a quantity, sometimes a large one, of *hag* or brushwood, which is the fuel used. Two or three rude forms or long narrow stools, a meal-chest or two, a brose-cap, milk-flagon, and spoon, constitute the entire furniture. The beds, bare, black, and hard-looking, are the most uninviting couches one could well conceive. The bed-clothes in colour very much resemble the potato-sacks I have seen in the field.

"I call at noon. The lads are making dinner—brose, of course —brose for ever! There is no spare cap or spoon for a stranger. In the midst of such comfortless accommodation a sense of degradation hangs about myself while I begin to talk to them of the value of piety, and urge them to self-culture, and observance of religious duties. I know that religion is fitted for the very lowest as well as the richest, and that no circumstances prevent the reception of her choicest blessings; but somehow I cannot help thinking that exhortations to family or private devotion in such places must appear very much like mockery, or manifestly useless. The consequences are not to me matter of wonder. The lads get out

as soon as possible. Instead of spending the evening there in self-cultivation, they go to visit a companion, or sweetheart, or anything rather than remain."

As a pendant to the above graphic description, we think it right to quote, from the report of the same minister, the following remarks upon an insalubrious indecency common in all our parishes, and a sad proof of the deficient sensibility to be expected from the inmates of such dwellings as we have been describing: "Many cottages—indeed the most of them, and not a few farm-houses—as yet know nothing of the luxury of a privy. Our parish school has nothing of the kind beyond the banks of the river. Everything with the children and youth of the place is quite natural; but I don't mean to say that my people are indecent, or that our place is pre-eminently filthy. Only they cannot help it, and the river sweeps away all our refuse to the ocean."

Having reported such facts, we are justified, we conceive, in declaring that the great want of our rural districts is healthful homes for the labouring classes, and in recommending an immediate reduction in the number of bothies, and the improvement of those permitted to remain. Bothies being such as they are, it is pitiable to think of the pernicious effects on their no less than 2170 inmates, especially the boys; and, we grieve to add, upon the many married men who, for reasons of misjudged expediency, choose, or are obliged, to leave their families in the neighbouring towns, while they themselves submit to the want of all domestic comfort by residing in bothies. This is one of the many evils arising from paucity of houses, and demands the immediate attention of those interested in rural affairs. How can the children of fathers living in bothies be trained up under the eye of their fathers? And if the children of ploughmen do not live in the country, where shall we get a supply of agricultural labourers? In answer to a remonstrance against placing a married man in a bothy, we have known a farmer reply to his minister, "It's all true, sir, but I have not another hole to put him in." This great evil originates in that deficiency of house accommodation of which we have said so much.

The (in this quarter) new and in every way undesirable system of bothies for female agricultural labourers is to be traced to that diminished supply of labour, to which also we have directed attention. Speaking of such labourers, the minister of —— observes: "It is deeply to be regretted that, from the want of house-work for young women, they should in their unmarried days have to pass through an ordeal of temptation from which very few come out unscathed." We need not point out how greatly that temptation will be increased by numbers of young women living together in bothies, and in an unnatural manner dissevered from the home circle, and its in general most gracious and humanising influences.

The growing tendency to employ females in the often rough labours of the farm is also traceable to the diminished numbers of the people living in the country; which we specially notice as an indication of the change perceptible in the mode of conducting the operations of husbandry, and destined to produce very important results.

Amid so much that is cheerless it is gratifying to be able to add that many of the brethren report an evident improvement in cottages as well as in bothies; but we are astonished to be informed that even in some improved bothies the men have not separate beds. We take the liberty of saying that a ploughman has at least as much need of a separate lair as has any animal on the farm! We also regard with much interest, and recommend to our brethren, the plans lately published by the Society for Improving the Condition of Agricultural Labourers, and which has been so much indebted to the benevolent zeal and intelligence of a minister within our Synod. The bill of Mr Dunlop, for facilitating the erection of houses for the working classes, is an important measure to which we solicit attention.

The nature of the house accommodation for agricultural labourers is closely connected with the manner in which they are hired as servants. Engaged at feeing-markets, they very often never see their future home till their arrival at it on the term-day. If they only had the prudence to examine their destined dwellings, and to insist on their being decently comfortable, a change for the better would instantly ensue.

As to the feeing-markets, we find considerable diversity of opinion among the brethren. Some denounce them as "slave-markets," equally degrading to masters and servants; while others have nothing to object to them save that they lead to drunkenness, and foolish expenditure of hard-earned wages. Some object to interfere with them on the ground of aversion to meddle with the question of wages, which, they seem to think, can only be known by the competition of a public market. It is certain that the subject is of more difficult adjustment than many imagine; and as to the evils charged upon these markets, we conceive that many of them are mere signs of the deteriorated condition of the farm-labourer, the market being simply the place where it is strikingly exhibited.

It is obvious, however, that when a man is looked upon as a mere working animal, and he is engaged by a master looking only to thews and sinews, the transaction *is* mutually degrading. Certificates of character (the writers of which should be conscientious from duty as well as from interest), and also of church-membership, ought to be invariably demanded by the master; while he, on the other hand, should be prepared to show that the houses provided for his servants are commodious and in good condition.

We see no reason, moreover, why farm-servants should be hired differently from domestic servants; and we have been furnished with proof that advertising for ploughmen has been the means of supplying a superior class of servants to those adopting this recently introduced mode of making known their wants.

The feeing-market for Forfar being on a Saturday, we are of opinion that much Sabbath desecration and domestic inconvenience may be avoided by its being held on another day of the week.

As to the religious and educational condition of agricultural labourers, candour constrains us to say that it is not so bad as might have been anticipated from their unfavourable circumstances. Their manners, it is true, are not by any means refined; many of them are coarse and profane in their language; the intercourse of the sexes leads to illicit amours; and at a feeing-market, and on New-Year's Day, there is considerable intemperance. Still, bearing in mind where they live, and how much they are neglected, it is astonishing that their vices are not more notorious. Their religious knowledge, it must be owned, is limited; and we believe that the experience of many of us is that of the minister of ——, who reports, "Their education has been very limited; to read with facility is far from an universal acquirement. Their morals are good; but I am not certain that the peculiar doctrines of the Gospel are distinctly comprehended by all, or that its ordinances are assiduously observed by all."

Irregular attendance at school till perhaps their twelfth year; becoming herds at that early age, and often at a distance from their parents, and in the families of careless masters; transference to the bothies some three years later,—all this constitutes such an education and training as would be desired by those wishing the people to perish for lack of knowledge. It is persevered in from custom, selfishness, and want of reflection. To counteract it, we urge the adoption of measures to rouse the too often dormant moral and mental susceptibilities of agricultural labourers in general, and of the bothy inmates in particular. We exhort our brethren to devote to *them* the most assiduous attention, *to visit them in their bothies*, and to abandon the common custom of formally addressing them in the farm-houses. Such as it is, the bothy-man prefers seeing his minister in the bothy; and his occasional visits there, his friendly conversation, and earnest admonitions, have a humanising influence on the atmosphere, physical as well as moral; and we have known several instances of young men becoming communicants in consequence of what they heard from the minister in the bothy.

While as Christian ministers it is our special duty faithfully, and without respect of persons, to proclaim the saving truths of the glorious Gospel of the blessed God, we fear that we must confess

that we have not been sufficiently bold, earnest, and persevering in telling landlords, factors, and farmers what religion and self-interest require them to do in ameliorating the mental, moral, and physical condition of the labouring classes. Let us now exert ourselves to keep alive and increase the better state of feeling recently evinced on their behalf; and while reprobating the coarse and shallow utilitarianism which regards their improvement as only a question of animal enjoyment, let us not think it beneath us to inquire into the domestic capabilities of "huts where poor men lie;" to ask how their scanty wages may be increased; to suggest schemes of provident economy; and, above all, instantly to do something for the increase of the means of training females in those womanly virtues, and in that knowledge of common things, the want of which often renders cottage-homes so remarkable for folly, dirt, and discomfort. The dark shadow of the mothers rests upon their children; and no great improvement in the condition of the rural labourer's family can be expected until his wife be more conspicuous than now she is for the possession of cheerful piety and skilful devotion to household duties. Entertaining these opinions, we regret to conclude our report with the statement that in the Synod of Angus and Mearns there is a want of female schools, of which, however, we cannot state the precise number.

In name and by appointment of the Committee on Agricultural Labourers.

DAVID ESDAILE, *Convener*.

TABLE.

CONDITION OF AGRICULTURAL LABOURERS IN THE SYNOD OF ANGUS AND MEARNS.

PRESBYTERIES.	Men.	Boys under Sixteen.	Female Outworkers.	Female House Servants.	Jobbing Men on day's wages.	Old Men unfit for labour.	Living in Houses of Masters.	Living in Separate Houses.	Living in Bothies.	Amount of House Accommodation, and whether favourable to preservation of health and decency.
FORFAR.										
Aberlemno, .	95	52	45	32	16	0	87	79	54	Inadequate and unfavourable.
Cortachy, . .	50	40	6	74	15	3	138	47	8	The same.
Dunnichen, .	39	19	22	13	20	8	47	25	21	The same.
Forfar, . .	55	22	19	36	70	22	40	12	25	No marked deficiency.
Glammiss, .	139	37	28	64	27	15	34	39	66	Much need of more.
Inverarity, .	100	40	30	70	20	4	100	34	70	Inadequate and unfavourable.
Kinnettles, .	63	6	8	16	4	0	5	18	40	Adequate.
Kirriemuir, .	175						56	56	62	Inadequate and unfavourable.
Oathlaw, . .	50	20	10	20	10	0	60	15	22	The same; damp and crowded.
Rescobie, . .	64	15	9	15	7	0	9	26	51	The same; some very bad houses.
Tannadice, .	163	25	20	40	25	10	80	68	110	By no means sufficient.
Total, . .	993	256	197	380	214	62	756	419	429	
BRECHIN.										
Brechin, . .	197	7	20	73	10	4	66	86	90	Inadequate, and in many cases very unfavourable.
Careston, . .	17	3	7	13	5	4	23	15	11	Sufficient and proper, with some exceptions.
Craig, . .	120	13	34	26	16	9	10			Tolerably good; much improved of late; some bad bothies.
Dun, . .	40	7	49	20	0	1	10	30	9	Sufficient, and favourable.
Edzell, . .	95	27	36	14	23	4	118	80	13	Inadequate and unfavourable, with few exceptions.
Farnell, . .	70	1	12	39	14	2	45	12	28	The same.
Fearn, . .	58	1	24	19	10	0	25	30	27	The same.
Lethnot, . .	60	0	13	13	3	2	12	18	30	The same.
Lochlee, . .	55	1	9	40	16	3	96	8	0	Enough, but materials coarse; straw thatch, no ceiling, floor of clay.
Logie Pert, .	100	6	20	40	2	6	50	60	20	Rather deficient; old houses bad; new improved.
Maryton, . .	67	0	12	14	0	0	14	37	32	Susceptible of much improvement.
Menmuir, . .	57	8	35	50	14	5	93	89	0	Enough; perhaps a third of houses unfavourable.
Montrose, . .	18	10	7	7	9	0	6	18	7	Plenty of good houses.
Stracathro, .	71	2	17	32	23	3	74	64	29	A few more houses needed; some bad.
Total, . .	1025	106	285	400	145	43	642	547	296	
FORDOUN.										
Arbuthnot, .	91	34	23	47	9	2	133	64	9	Greatly improved of late; bothy system almost unknown.
Benholm, . .	63	16	9	14	16	1	53	31	8	Inadequate and unfavourable.
Bervie, . .	63	12	7	19	14	5			14	Adequate and favourable; bothies good.
Cookney, . .	198	30	42	42	40	12	175	40	16	Adequate, but needs much improvement as to its nature.
St Cyrus, . .	140	30	30	72	20	0	48	73	71	Plenty of houses; some unfavourable; bothies miserable.
Dunottar, . .	68	25	17	35	20	12			18	Scanty, and improper in general.
Fetteresso, .	196	45	12	176	57	45	156	20	20	Not to be complained of.
Fettercairn, .	233	29	97	36	75	7	142	217	22	Needs much improvement, though amount adequate.
Fordoun, . .	201	76	35	88	55	10	67	90	37	Inadequate and unfavourable.
Garvock, . .	58	24	20	19	6	1			6	Rather inadequate, but not very unfavourable.
Glenbervie, .	120	34	18	42	37	25				Believed to be favourable.
Kinneff, . .	95	30	25	35	45	6	80	80	25	Tolerably wholesome.
Laurencekirk, .	98	18	25	40	70	16	77	114	17	Amount perhaps sufficient; many old and bad houses.
Marykirk, . .	123	30	22	36	30	0	96	60	24	Scarcely sufficient.
Total, . .	1747	433	382	701	494	142	1027	789	287	
MEIGLE.										
Airlie, . .	120	16	20	33	15	5	10	45	74	Perhaps enough; but far from comfortable; improving of late.
Alyth, . .	110	45	40	35	40	8			60	Insufficient and improper.
Bendochy, .	131	20	32	16	10	1	48	34	47	Miserable in amount and quality.
Blairgowrie, .	122	47	43	28		0	171	35	42	Not enough.
Cupar-Angus, .	67	8	22	12	6	0	5	44	18	Not so deficient in amount as in decent family accommodation.
Eassie, . .	55	12	24	21	14	2	36	65	27	Enough; sometimes defective in its nature.
Glenisla, . .	132						77	46	0	Enough, but of a very humble description.
Kettins, . .	120	27	57	45	26	4	75	89	58	Not enough, and generally too small; old bothies bad; new better.
Kingoldrum, .	81	16	14	29	15	0	65	54	40	More needed; most unfavourable.
Lintrathen, .	109	55	35	30	10	6	89	62	23	Inadequate, and in some instances unfavourable.
Meigle, . .	41	9	8	16	17	0	40	29	22	Adequate and favourable.
Newtyle, . .	42							30	12	Better houses needed.
Ruthven, . .	26	6	10	40	4	2	19	16	11	Inadequate and unfavourable.
Total, . .	1156	261	307	305	157	28	635	549	434	

[Table continued.

PRESBYTERIES.	Men.	Boys under Sixteen.	Female Outworkers.	Female House Servants.	Jobbing Men on day's wages.	Old Men unfit for labour.	Living in Houses of Masters.	Living in Separate Houses.	Living in Bothies.	Amount of House Accommodation, and whether favourable to preservation of health and decency.
DUNDEE.										
Abernyte, . .	28	7	18	7	7	1			9	
Auchterhouse, .	122	5	28	14	10	0	21	68	33	Inadequate and unfavourable.
Broughty Ferry,	10	1	0	1	0	0	3	0	0	The same.
Dundee, . .	32	12	21	22	15	7	5		23	Needs great improvement.
Inchture, . .	75	13	25	43	24	12	43	58	42	Inadequate and unfavourable.
Kinnaird, . .	48	8	14	12	27	4	20	93	0	The same.
Liff and Benvie,	109	33	66	42	51	14	30	147	27	Good, with one exception.
Lundie & Fowlis,	163	17	40	14	11	1	39	105	19	Inadequate and unfavourable.
Longforgan, .	97	19	43	32	27	13	45	157	37	Adequate, with few exceptions.
Mains and Strathmartine,	70	35	40	30	35	25	12	30	43	Enough; some tolerable, some abominable houses; improving.
Monifieth, .	72	13	47						41	Enough houses; some excellent, others unhealthy.
Monikie, . .	111	35	30	82	64	23	107	163	75	Generally very inadequate.
Murroes, . .	65	26	12	35	8	6	35	12	60	Inadequate, with few exceptions.
Tealing, . .	86	29	9	36	25	8	47	55	61	Mostly adequate, and favourable.
Total, . .	1088	253	393	370	304	114	407	888	470	
ARBROATH.										
Arbirlot, . .	88	30	70	31	26	5	38	102	40	Inadequate and unfavourable.
Arbroath, . .	11	6	4	5	0	0	14	7	0	No bothies; houses respectable enough, as things go.
Barry, . .	54	0	4	14	12	0	20	24	10	Sufficient.
Carnoustie, .										
Carmyllie, .	151	34	23	47	27	7			24	Very respectable in general.
Friockheim, .										
Guthrie, . .	28	16	4	8	14	6	37	26	16	Not enough; generally favourable.
Inverbrothock, .	5	2		4			4	4	4	[bothies much improved.
Inverkeillor, .	129	26	55	50	26	5	86	102	103	Adequate for jobbing men; scanty for families;
Kinnell, . .	57	11	12	21	6	1	24	43	29	More needed; sometimes damp and confined; one
Kirkden, . .	26	13	10	14	10	0	24	22	27	Limited, and often not good. [bothy a model.
Lunan, . .	28	6	18	15	7	2	24	52	0	Adequate, with few exceptions; no bothy.
Panbride, . .	72	4	25	37	20	8	0	75	26	Enough; some houses good, some very bad.
Vigeans, St, .	179	29			21		46	75	75	
Total, . .	828	171	225	421	169	34	303	525	254	

GENERAL RESULT.

PRESBYTERIES.		Men.	Boys under Sixteen.	Female Outworkers.	Female House Servants.	Jobbing Men on day's wages.	Old Men unfit for labour.	Living in Houses of Masters.	Living in Separate Houses.	Living in Bothies.
FORFAR PRESBYTERY,		993	256	197	380	214	62	756	419	429
BRECHIN	Do.	1025	106	285	400	145	43	642	547	296
FORDOUN	Do.	1747	433	382	701	494	142	1027	789	287
MEIGLE	Do.	1156	261	307	305	157	28	635	549	434
DUNDEE	Do.	1088	253	393	370	304	114	407	888	470
ARBROATH	Do.	828	171	225	241	169	34	303	525	254
Total,		6837	1480	1789	2397	1483	423	3770	3717	2170

Presented to the Synod of Angus and Mearns by the Committee on Agricultural Labourers, 22d April 1856, in name and by appointment of the Committee.

DAVID ESDAILE, *Convener*.

NOTE.—The compiler of the above has used, so far as possible, the words of the reports received from the parochial clergy, in answer to queries addressed to them under the authority of the Synod. But, all qualifying statements being omitted in such an abstract, certain opinions of the reporters may appear too unqualified. Allowance should be made for imperfections unavoidable in such a compendium of statistics. Greater scope for the expression of individual opinion was afforded by the detailed report presented to the Synod along with this statistical table.

SEWAGE-WATER OF MANUFACTURING TOWNS.

By Fras. Wrightson, Ph. D., Birmingham.

The following analysis of the sewage-water of Birmingham, and of the spontaneous deposit which forms by its subsidence, may possess some interest at the present time, when so many schemes are afoot for converting liquid sewage into a concentrated and available form. Whilst in some respects the sewage of this town differs considerably from that of smaller manufacturing towns, and also from that of larger towns and cities, such as Liverpool or London, it is the same in this particular, that the valuable constituents are present in an *extremely dilute* form; and although I believe a plan is in progress for receiving the sewage into an immense tank or reservoir, and, by allowing it to subside and deposit its solid suspended contents, form a source of great profit to the Corporation, the following analysis made of the water taken from its main outlet into or near the intended tank, ought to demonstrate the futility of such a scheme; if, indeed, anything were needed after the careful investigation on sewage of Professors Anderson and Way. If Analysis II. be compared with an analysis of Professor Anderson ("Composition of Two Manures produced by the Precipitation of Sewage Water") published in *Transactions of the Highland and Agricultural Society*, January 1856, the composition will be found very similar, with the exception of the metallic sulphurets, which of course result, in the Birmingham sewage, from the precipitation of the metals in solution by the hydro-sulphuric acid disengaged from the decomposing organic matter. The secret of the "valuable process" alluded to by Professor Anderson, no doubt consists in passing the sewage through layers of coarse sand. No. I. is an analysis of the solid matter obtained by evaporation of the sewage, from which the solid or undissolved floating matter had been separated by filtration through a little fine muslin; a little sulphuric acid was added in slight excess during evaporation, to prevent the loss of ammonia or its carbonate. The filtered sewage was a semi-opaque fluid, and deposited nothing further upon standing.

Finding from the analysis that the ammonia in the sewage was much less than I anticipated, I was at the trouble, residing several miles from the sewage outlet, to have the water collected at different periods of the day, and found, of course, that the proportion of ammonia varied considerably, being greatest for Birmingham about mid-day. The quantity of earthy phosphates held in solution seems to depend more on the alkalinity or acidity of the water, which varies from slightly acid to alkaline during the day. The

acid reaction is caused by the acid sulphate of iron (pickle waste) thrown away from the manufactories. An analysis of this liquid I have made for one of the manufacturers, shows that, from this one manufactory alone, sulphate of iron equal to about 3 tons of green copperas, besides excess of acid, passes weekly into the sewers. Perhaps this fact may merit the consideration of our sanitary reformers.

How much of the sulphur now lying innocuous at the bottom of the sluggish river Rea as sulphuret of iron, might not have been borne as sulphuretted hydrogen charged with noxious miasma from the sewers into the streets and dwellings of a thickly populated town, during the prevalence of epidemic or contagious diseases, for the last twenty years, unless it had been arrested and fixed in the act of escaping from decaying organic matter by those waste metals in solution? Numerous facts show that gases, such as sulphuretted hydrogen, ammonia, &c., act as vehicles for contagious miasma.

Many causes have been assigned for the almost entire exemption of Birmingham from cholera; may we not add this to the number? The large quantities of nitrous and sulphurous acid gases given off from the oil of vitriol works no doubt exercise a salutary influence in this respect. Care was taken to obtain each of the specimens of sewer-water upon a dry day. I have no means of estimating its quantity with accuracy. I may observe that the liquid sewage has been for years floated on to the adjoining meadows, adding greatly to their fertility; and it will be much to be regretted if its facile use in that way be abandoned to pursue a fallacious scheme, which science demonstrates to be (for the present at all events) impracticable.

I.—ANALYSIS OF SOLID RESIDUE left on evaporating the Filtered Sewage Water, after the addition of a slight excess of Sulphuric Acid, dried at 212° Fahr.

	Water collected June 29, 1855, 6 P.M.	
Silica, sand, &c.,	0.99	
Phosphate of lime,	1.05	
Carbonate of lime,	9.31	
Sulphate of iron,	2.68	
Sulphate of lime,	22.40	
Sulphate of magnesia,	9.13	
Sulphate of soda,	2.74	
Sulphate of potash,	3.87	
Sulphate of ammonia,	2.07	= 0.53 ammonia.
Chloride of sodium,	35.77	
Organic matter, minute quantity, water, and loss,	9.99	
	100.00	

The filtered water had a specific gravity of 1000.2; and 1000 parts, evaporated to dryness at 212°, afforded 1.56 solid matter.

II.—Analysis of Slimy Deposit taken from the bottom of the outlet of the Birmingham Sewers into the Rea, dried at 212° Fahrenheit. Collected at the same time as the water.

Sand, &c.,	32.67
Proto-sulphuret of iron,	8.69
Sulphuret of copper,	0.30
Sulphuret of zinc,	0.52
Sulphate of lime,	1.42
Phosphate of lime,	2.50
Carbonate of magnesia,	0.40
Organic matter,* containing 33.00 carbon and only 0.25 nitrogen, with a little water,	53.41
	99.91

Of course, a deposit formed in the aforesaid tank would differ from this only in containing less sand or earthy matter.

For the better oversight of the following analyses of the sewage-waters, I place them in the order of the time of day at which the water was collected.

Sewage-Water of Birmingham.

When Collected.	Specific Gravity of Water.	Dry Matter in 1000 parts of Sewer Water.	Dry Matter contains, in 100 parts— Sulphate of Ammonia.	Ammonia.	Phosphate of Lime with a little Oxide of Iron.
1856. January 4, 8 A.M.	1000.46	0.71	2.85	0.73	1.10
January 10, 10-30 A.M.	1000.53	0.95	10.50	2.70	1.10
January 11, 12-30 P.M.	1000.90	...	11.55	2.97	1.80
1855. December 28, 12-30 P.M.	1000.90	1.09	11.34	2.92	...
1856. January 18, 2 P.M.	1001.21	1.03	10.90	2.80	1.02
1855. December 4, 4 P.M.	1001.10	1.29	3.34	0.86	1.10
December 1, 6 P.M.	1000.28	0.56	1.74	0.45	1.30

From the foregoing analyses it appears that the average quantity of solid matter held in solution in the sewage-water is pretty nearly one part in a thousand.

The average of the ammonia is 1.74 parts in 100 of the solid matter, or 1.21 grains in the gallon of 70,000 grains. This is little more than one-third of the amount contained even in the

* Besides wood fibre and humus-like matter, this contained much fatty or oily matter. A "combustion" was made.

Morningside sewage-water: the low specific gravity, and the small amount of solid matter, further indicate how largely the sewage becomes diluted in manufacturing towns.

The average quantity of solid matter held in suspension, and deposited either by standing or by passing through fine muslin, I found to be 21 grains to the gallon. From several qualitative examinations (also partially quantitative), the composition appeared very much the same as that of the "slimy deposit" of which I have given the analysis, excepting that the proportion of sand or earthy matter was considerably smaller in the former than in the latter. On comparing these analyses with some analyses of the sewage-water of Croydon and Rugby made by Professor Way (*Journal of Royal Agricultural Society*, No. XXXIII, 1854), I find they do not differ more than I should anticipate. All the specimens were collected at the main outlets, but they all differ widely from the analysis of the "London Sewage" given in the same Journal, which seems, in fact, to have been, more strictly speaking, cesspool drainage. For obtaining data of this nature, the water should always be taken from the *outlets* of the *main sewers.*

UNIVERSAL AGRICULTURAL EXHIBITION AT PARIS.

By PETER M'LAGAN, Younger of Pumpherston.

HAD any one ventured, at the commencement of this century, to predict its character from the events which were passing about that time, he never would have foretold what has been taking place of late. The battles of Marengo, Alexandria, and Copenhagen, fought in 1800 and 1801, indicative of the bitterest feelings of hostility between some of the principal kingdoms in Europe, and which was hereditary in the case of England and France, were but unsuitable preludes to that reign of peace which has subsisted in Europe with but little interruption for the last forty years, and to that international amity which has been displayed of late.

The energies of those nations which had been spent in war, have been devoted to the advancement of the arts of peace—their internal resources have been developed—progress in agriculture, commerce, and manufactures, has been encouraged at home, and excellence in them introduced from abroad—the rabid thirst for blood, and the raging of the fiercest passions in the human breast, always the result of war, have been displaced by a love which knows not the boundaries of countries—by an earnest striving to raise nations to a higher place in the social scale. Kingdoms have been united by the iron bands of railways, and by the still more powerful, though less apparent, influences of commerce—oceans have been spanned, and the thoughts and wishes of man, once expressed, wing their noiseless way with lightning speed through the dark caverns of the deep, over mountain-tops to far distant friends.

The Exhibition of 1851 was therefore a fitting inauguration of the commencement of the second half of a century so distinguished. Beneath the vaulted crystal roof of the Exhibition building a festivity of peace was celebrated, a jubilee of nations was held. Magnificent in its proportions, spacious in its area, stupendous in its height, fairy-like in its embellishments, it had concentrated within its walls the results of applied genius and thought, specimens of the skill, enterprise, and industry of a forty years' peace, and of the natural products of almost every country. The flags of nations, once the most hostile to one another, floating together, or emblematically interwarping in peaceful folds—the unceasing play of the fountains and refreshing sparkle of the waters—the verdure of the plants—the thousands of human beings of every country absorbed in wonder and admiration—the hum of voices conversing in almost every language, while ever and anon the music, stealing forth from some unseen source, swelling out in beautiful harmony, and dying away amid the vast space,—all tended to produce such a feeling of peace and composure, such a fairy scene as is rarely experienced and witnessed.

But still, grand as was the conception of the Industrial Exhibition, perfect as was its execution, and successful as were its results, there was unquestionably a want in it which succeeding exhibitions have but made more apparent to us. Agriculture was not there fully acknowledged as one of the greatest, if not the principal art of peace—as one of the great sources of the industry of all nations. True, its exhibition of agricultural implements under the same roof as the machines of the other industrial arts, was such as to astonish all the visitors, and to draw forth the following remarks from one of the most philosophic observers that ever visited this country :—

"When the Great Exhibition attracted to London," says M. Lavergne, "an immense concourse of curious from all parts of the world, strangers were struck, but not astonished, at the great industrial and economical power of the English. . . . . But what caused surprise to more than one observer, was the agricultural development displayed in those departments of the Exhibition set apart for implements of husbandry and English agricultural produce. Of this no idea had been formed."

But that important branch of agriculture, the breeding and rearing of cattle, the raising of those living machines so necessary on every farm, so important to every country, was entirely forgot in the great international programme. The results of the exercise of that genius, skill, industry, and perseverance in adapting those living machines to the purpose for which they are required, certainly of a higher order than the employment of the same qualities in constructing machines of wood or iron, were for the time overlooked as proper subjects for competition among all nations. At Windsor, no doubt, was seen what the agricultural interest of England could do when it put forth its strength; but while foreigners were in-

vited to go there and admire, they were not invited to compete. Nor was this considered at the time or since any oversight, till the Emperor of the French showed that in all the international exhibitions up to 1855 there had been this omission.

To Napoleon III. must be ascribed the honour of having opened up to agriculture the same advantages of competition as to the other industrial arts in the international exhibitions. The success which attended the International Agricultural Show held last year in conjunction with the Great Exhibition of all nations, induced him to offer premiums for similar shows for this year and next. His wisdom is apparent in this resolution, as it has been in many other cases of his policy at home and abroad. No surer plan could have been taken to stimulate the farmers of France to exertion and improvement, than by bringing to their very doors the best of every breed of cattle and sheep, and the best of every agricultural implement, from which selections might be made to improve their own native breeds, or economise labour; and by the study of which a spirit of inquiry would be roused, which could be satisfied only by the adoption of improved methods of farming. No person in the habit of reading the French Agricultural Journals could fail to be struck with the interest which has been excited there in agricultural matters since last year's Exhibition. To the foreign exhibitors of stock at these shows the boon conferred is incalculable, for now has been afforded them for the first time the opportunity of comparing their own stock, in whose favour they are probably and most naturally prejudiced, with animals from all parts of the world, and in a few days' inspection observing what the most advanced agriculturists in the world have done in the improvement of live stock and implements. And this too they are enabled to do at comparatively little cost, owing to the extreme liberality of the French Government, and perhaps at no little pecuniary profit, if they should be successful in carrying off some of the very handsome premiums offered by the Government.

To agriculture, then, has been assigned the first place of the industrial arts by the French Emperor; for while last year concluded the exhibition of the products of the other arts in France, premiums for two years more have been offered for those of agriculture. Were this but an acknowledgment of the inferiority of the agriculture of France to that of some other countries, it would bespeak the discernment of the Emperor in being able to discover its defects, and anxiety on his part to improve it. But while France cannot be said to occupy the first place in the practice of agriculture, it is second to none in the science; for Boussingault, Payen, Dumas, Barral, and Lavergne, are names that will ever hold a high place among the agriculturists of the world. Nor are we to suppose that agricultural shows commenced in France only last year. Agricultural societies have been long established throughout the country as they are in Britain, and local shows and a general

show at Paris are held annually, at which premiums are given by the Government; and lithographs are taken from daguerreotypes of those animals which have gained prizes. One of the conditions imposed on the successful competitors this year also, was, that they shall allow daguerreotypes of their animals to be taken.

The liberality and magnificence shown by Napoleon III. and his government, in carrying into execution the idea of an international agricultural exhibition, has been as great as its conception was bold. The principal building used last year for the Exposition of the Industry of all Nations was set apart this season for the Agricultural Show. It is a noble permanent structure, rectangular in its plan, but relieved from that uniform deadness which the walls of buildings of this form often present, by projecting pavilions at the corners, and the centres of the north and south sides. The principal entrance is through the pavilion on the north side, the front of which is gorgeously ornamented by groups of sculpture, designed and executed by some of the principal artists in France. Round the walls, and about half-way between the roof and the foundation, a row of escutcheons are sculptured, bearing in gilt the names of some of the principal towns in France; and immediately below it, another architectural division or frieze, on which are gilt the names of celebrated men of all nations of ancient and modern times. Contrasting this building with the Crystal Palace raised for the Exhibition of 1851, Englishmen are apt to find fault with the great outlay of money which has been caused by erecting such a permanent structure for such a temporary purpose; but they are perhaps not aware that the Palais de l'Industrie was built more for another purpose than for the Exhibition of 1855. Every five years an exhibition of the national manufactures of France is held in Paris, for which temporary erections used to be made, which were always attended with inconvenience and expense. The necessity of having a structure which would be sufficient for specimens of the industry of all nations last year, in imitation of the example of England in 1851, suggested to several individuals the idea of erecting a permanent building which could be used, after the international exhibition, for the quinquennial exhibition and other purposes. A company was therefore formed, and by them the present edifice was erected.

The interior of the building is divided into an extensive area in the centre, and galleries round the walls, which are supported by iron pillars; the whole is lighted from the glass roof, and about six hundred windows round the building. All the internal arrangements have been made with that taste and skill for which the French are so distinguished. The centre area is converted into a garden, laid out in flower-beds of every form which taste could suggest, and bearing solid masses of blossom of every tint and of the most delicious fragrance, while the constant play of the fountains from among the shrubs, the refreshing trickling of the waters, and the lively

songs of the birds from an aviary, produced such a scene as we are accustomed to look for only in descriptions of fairyland. As this was a horticultural exhibition as well as agricultural, the flowers which added so much to the charms of the scene were all entered for competition; and the fountains were a study of themselves, from containing fish of all stages of growth, from the spawn to the full-grown animal. Premiums were also awarded to the best cultivator of fish, the art of pisci-culture being now regarded as a most important economic one. If we are to judge of the state of horticulture in France from the specimens we saw exhibited, we must say that we have a great deal to learn from them in this art. The flowers were most perfect, and the vegetables for kitchen use were large almost to a fault—amongst which we might mention some specimens of asparagus.

Under the galleries, stalls were put up for the cattle, every animal having the full space of an ordinary horse-stall allowed him. Every fifteen cattle were put under the charge of two French servants, who not only had to keep them clean, supply bedding, and every now and then wash out the gutter behind them, but had to sweep, and preserve in a proper state of moisture, all the passages about the cattle, so that there were no disagreeable effects from dust. Ample space being allowed for passengers, there was no discomfort arising from crowding, though the numbers of spectators were very great. We were particularly struck with the fork which the cattle-keepers used for dressing up the bedding of the animals. It is entirely of wood, being nothing else but a straight stick, extending into two prongs at one of its ends. If the distance between the prongs is not sufficiently great, the stick is split at the joining, a wedge is inserted to keep it open, and a piece of iron is bound round the stick to prevent the slit extending farther up, and to keep the wedge in its place. The injuries which occur so frequently from pricks to cattle and horses by our iron forks, from accident and carelessness, have induced us to suggest a trial of these wooden instruments in both our byres and stables. Everything in this department was so beautifully arranged, that no one, excepting the most hypercritical, could find fault with any part. The hunting-stables of the most particular sportsman in England, are not more beautifully kept than this byre, in which there was nothing to offend the senses of the most fastidious.

As there was not sufficient accommodation for all the stock in the principal building, extensive temporary erections were made for some of the cattle, the sheep, poultry, and heavy implements. So complete were all the arrangements, that there was no exhibitor who could have the least cause of complaining that due attention had not been paid to his stock. Indeed, so vigilant were the servants in charge of the stock, that sometimes rather disagreeable and awkward incidents occurred to the exhibitors, who, being unknown to the French servants, were prevented from touching their

own stock; and, as generally happened, each party not understanding a word of the language of the other, a fight of words took place, to little purpose, but much to the amusement of the spectators. The food given to the cattle was good hay and ground grain, which the animals appeared to relish much. Latterly, some green food has been allowed the sheep, but at first they too had to be content with the dry hay. There was nothing which struck us more than the great activity which the French display in making their arrangements. A few days sufficed to convert the centre of the building, which was quite bare of flowers, into a beautiful garden; and sheds and other accommodations, when required, rose as it were by magic.

The larger implements were all placed, as already stated, in outer sheds, and the smaller ones and the agricultural products in the galleries in the permanent buildings. However useful to exhibitors the plan adopted in the arrangement of the implements, it was certainly anything but convenient for the Judges and the spectators. Every exhibitor was allowed a stall for his heavy implements in the outer sheds, and another for his smaller ones in the galleries. It was therefore next to impossible to make a comparison of those of one kind.

After the great exertions made by the French Government, and the liberality shown by them, not only in being at the whole expense of the keep of the stock so long as they are in France, but in the munificent offer of premiums which they have made to the amount of nearly £7000, besides innumerable medals of gold, silver, and bronze, for agricultural produce, for which no money-premiums have been awarded, it would certainly have been uncourteous in other nations not to have responded to the invitation given them of exhibiting stock, implements, and produce. The large volume containing a list of the entries, of nearly 500 pages, shows that they have fully appreciated the exertions made by France, and have acknowledged her services in the great cause of agriculture, by assisting in sending their stock, implements, and products, to make the Exhibition worthy of the nineteenth century.

We find, then, that there were entered—

For Cattle,	1302
... Sheep,	729
... Swine,	171
... Goats, Rabbits, &c.,	81
... Poultry,	375
... Pigeons, &c.,	99
Live stock,	2757
Implements,	2108
Produce,	4635
Pisci-culture,	51

If we compare this with what was exhibited at Glasgow in 1850, the largest show held under the auspices of the Highland Society, and at Windsor in 1851, held by the English Society in the year

of the Great Exhibition, we will be better able to estimate its magnitude, particularly when we consider that everything exhibited is under cover, and when we take into account the immense distances from which some of the things have been brought:—

Shown at Glasgow in 1850.	
Cattle,	480
Horses,	164
Sheep,	639
Swine,	85
Poultry,	172
Total live stock,	1,545
Implements,	577
Dairy produce,	316

Entered at Windsor in 1851.	
Cattle,	385
Horses,	120
Sheep,	316
Swine,	167
Total,	988

The show of implements was in the Crystal Palace, and there were no poultry shown.

The most interesting and instructive part of the Exhibition, in my opinion, was the show of cattle. About forty different classes were exhibited, all possessing characteristics which were in a great measure due to peculiarities of climate, uses, and management. The effects of climate on the animal creation are too well known for me to enlarge upon them here; it produces such differences in individuals, even of the same breed, as through time to constitute them types of a distinct race, *cæteris paribus*. An improved short-horn or Leicester sheep, if taken from the rich pastures and comparatively good climate of its native counties, and introduced to some of the high districts of Scotland, even though the same treatment and the same quantities of forced food were continued to it, if subjected only to a similar exposure as formerly, would, in the course of a few generations, soon lose its distinctive qualities. This is well understood by breeders of Leicesters in the higher districts, who, considering it almost impossible to maintain the fineness of their stock by breeding from those stocks about themselves, always infuse new blood from those in the lower districts. So the Holland cows, fed on the luxuriant pastures of the drained lakes of their native country, show a fuller form, and points which indicate an aptitude to fatten, which are not brought out in the same degree when we meet with them in higher districts on the Continent. This distinction is well marked in individuals of the same breed from different parts of the Continent, as exhibited at the Paris Show.

In estimating the value of cattle in this country, there are only two things which we take into account, their milking and their fattening qualities. These two qualities divide all our breeds into two classes, the one represented by the Ayrshire, the other by the improved short-horn. In judging, however, the cattle exhibited at the Paris Show, we must take another quality into consideration, viz. their fitness for labour. And in making a survey of the foreign breeds, there was nothing with which we were more struck than that appearance which has been given them by the attention

of breeders to the improvement of this quality. In fact, in most of the breeds, the production of an animal better adapted for labour than for giving milk or flesh, appears to be the aim of the foreign breeder. A disproportionate size of bone, an undue development of muscle, fleshiness—or lyariness, as it is called in Scotland—detract from the appearance of a cow that possessed points which would entitle it to be reckoned a good milker or feeder. As an instance of this, I would mention the Fribourgeoise, the Bernoise, and in some degree the Swiss breeds. The last of these, in particular, are large behind and tapering before, with well-placed milk-vessels; but they have a coarseness of appearance, arising very much from their comparatively large bones and fleshiness. In the former two, weight appears to have been an important element, for they are large, and though by no means so well shaped as the Swiss, are not deficient in points indicating good milkers. The same remarks apply to all the other races in the north of Switzerland, and the Italian provinces of Austria. I may mention that the cows from the Swiss cantons in general are of a tawny, mouse, or dun colour, and from the accounts given of them by the owners, are esteemed as good milkers. The English breed which appears to come most nearly to the Continental ones in appearance is the Devon, which is as useful for labour as for milk and beef.

With these remarks as to the proper attention necessary to be paid to the qualification for labour in the foreign breeds of cattle, in judging of the forty different classes exhibited, we will proceed to classify them into two great divisions, viz. the milk-producing and the beef-producing breeds.

Pre-eminently did the Ayrshires and Alderneys stand first in the first division; and the former received the impress of the approval of the foreign agriculturist, by the rapidity with which they were bought up—a rapidity unequalled by that of any other breed, excepting the Bretons. Next to them we would place the Holland cattle. They are generally heavier than the Ayrshire, as might be expected from the greater luxuriance of the pastures, or from the system of soiling being more practised in the districts from which they have come. But there are some of them perfect in shape as milkers. They are not unlike the old Dutch cows which are yet to be met with now and then in some districts here, and are no doubt the origin of our common country cows, now so generally displaced or crossed by the favourite Ayrshires. Next we must place the Swiss breeds, the Kerry, the French Normand, Flamand and Breton, the Jutland, the Bavarian, the Saxon, and Bohemian cattle. The Swiss cattle we have already remarked on. The Normand and Flamand are large, and though highly esteemed in their country as milkers, with no doubt favourable indications of such, we would be inclined to recommend them principally for those situations where climate and soil were good, and a consider-

able value were put upon their progeny for being reared, as well as upon their milking properties. For we do not know any breed of cattle which combines size and milking qualities in the same degree as they do, and that would throw a better cross with the short-horn for feeding purposes, than these large Normands and Flamands; for it must be remarked that, though large, they are by no means coarse. The Kerry, Breton, and Jutland cattle must be classed together, as being all small, having good shapes as milkers, and well adapted for districts where the pasture is rather bare. There was no class of animals in the Exhibition which met with as ready a sale as the Bretons. They were the admiration of every one who saw them. Small and beautiful, with a neat head, a full large gazelle eye, amiable countenance, and quiet disposition, they gained the favour of the ladies, and are as much prized by them as pets as for their milking qualities, which are good. In reference to the division of the different breeds of cattle we have given above as milkers, we may state that it agrees with the results which have been obtained at the Imperial school of Grignon, from carefully-conducted experiments. The Ayrshires are found there to give the largest quantity of milk in proportion to the quantity of food consumed, the Swiss cattle the next, and the Bretons next. There were no Dutch cattle at the farm. The Shetlanders, if exhibited, would have been classed with the Bretons, which they resemble. In mentioning these cattle, it must be understood that I do so more as types; the Swiss cattle, for instance, include all those from the Tyrol, Styria, &c., which are entered as distinct breeds; the Dutch cattle, those from the Polders of Holstein, &c. The truth is, the differences between many of the breeds entered as distinct, are no greater than what we might have expected to have taken place in the same breed from a change of climate, of food, and of treatment.

Of those breeds better adapted for feeding than for milk, the Durhams, or improved short-horns, stand first. It is needless here to dilate upon the excellent qualities of this breed. Agriculturists from all parts of the world have marked their appreciation of their value by the large sums which they give for them yearly in Britain; and the large number shown at the Exhibition by Frenchmen, both of animals reared in Britain and purchased by them, and of those reared in France by themselves, show that the French are fully alive to the excellence of the breed. There was perhaps no class of stock which excited more the interest of the spectators, particularly of that portion of them engaged in agriculture, than this breed. Next to the Durhams we must place the improved Herefords, which are alleged by their admirers to rival the former in precocity, when treated as liberally. Of the foreign races, none of which approach in symmetry the Durhams, we would place first the Charolaise, which are pure white, and possess many of the qualities which distinguish the improved short-horns—such as quietness of disposi-

tion, fineness of bone, delicacy of touch, and beauty of form. Next to them we would place the Garonnaise, Agenaise, Bazadaise, and Comtois. These may be all considered analogues or congeners of the same race represented by the Garonnaise, a favourite breed of cattle found on the plains of the Garonne. It is held in high repute by the inhabitants of the ancient province of Guienne, and is considered by some of its admirers to be the origin of the Durhams. They allege that it can be proved from authenticated documents that the English, when in possession of this province, at different times for about two hundred and fifty years—from 1152 to 1453—appreciated the good qualities of the breed; and Arthur Young is known to have thought highly of them, when travelling through France. At the fat show held at Bordeaux, the capital of the province, in March last, one of the judges is reported to have said, "Here are our Durhams, possessing almost the same colour, the same form, the same portliness, the same aptitude to fatten, and the same early maturity." I can only say that the specimens exhibited at Paris did not support this encomium. They are by no means equal to the improved shorthorns, for though they do appear to lay on their beef pretty equally, they possess that fleshiness of which we have spoken before as arising from the practice of employing them for labour.

The next breed we have to mention is one that must be classed by itself, viz. our polled cattle. The show of them was exceedingly good, and most creditable to Scotland. They were objects of curiosity, not only to foreigners, but to many English who had never seen specimens of the breed before. In no breed are the effects of a proper attention to the principles of breeding more apparent than in this; for in the same district there may almost be said to be two distinct breeds, so great is the difference between the improved and the original. As quite opposite to polled cattle, we may mention the Hungarian, which are distinguished by horns about 2 or 3 feet long, extending straight out from each side of the forehead, coarse, leggy, thin-backed, flat-sided animals. They are the same breed which are so much used in the steppes of Russia and in the Crimea as beasts of burden, and from their peculiar conformation are well adapted for getting more quickly over the ground than animals of more perfect form.

The mountain breeds, comprehending our West Highlanders and the Race de Salers, next demand our attention. Perhaps we should have included the Kerrys and Bretons here; but as we have mentioned them before as milkers, we will not allude to them further at present. The show of West Highlanders was not good, owing as much to the want of condition in the animals as to inferiority of quality. The time of the year was the worst that could have been selected for showing them, viz. just when they are casting their hair; and they do not, besides, appear to have

agreed with the confinement to which they had been subjected. The French, therefore, had not a favourable opportunity of judging of that breed, which one of their countrymen called "one of the most wonderful creations of man." The Race de Salers includes the cattle of Aubrac, Limousin, and Auvergne. This breed occupies the place among the French cattle which our West Highlanders do among the English. Reared in a district similar in geological formations to our Highlands, composed of granite and gneiss mountains, which rise several thousand feet above the level of the sea, they have all the hardiness of the Scotch breed. No race is said to combine in a greater degree hardiness, fitness for labour, with good milking qualities, and an aptitude to fatten when they are well fed. In Auvergne the cows are allowed to go for six months of the year in a half-wild state, pasturing on the hills in summer, and folded at night. And in the moist plains of Normandy they are prized for their working and fattening qualities, becoming fat on pastures where the Norman cattle could scarcely exist. Those exhibited were generally larger than the West Highlanders, smoother in the coat, probably arising from better keep during the winter, and are red or light grey in colour.

If in making a comparison between the different breeds of cattle as exhibited at Paris, we had to take into account a quality much prized on the Continent, but wholly disregarded here—viz. fitness for labour—we must bear in mind also, in judging of the sheep, that while the production of mutton is the principal aim of the British sheep-rearer, the production of wool is that of the Continental. Of the two there is no doubt that the former, viz. the production of mutton, is the most valuable. This difference of aim in the British and Continental stock-masters enables us to divide the sheep, as exhibited at Paris, into two distinct classes, viz. those kept principally for the production of mutton, and those kept mainly for the production of wool, which will include all the different varieties shown, not even excepting those which peculiarities of climate and situation compel the inhabitants to keep. For we may assert, without fear of contradiction, that the production of fine wool is incompatible with early maturity and aptitude to fatten, or rapid production of mutton, in the same breed of sheep.

To the former class belong all the British breeds exhibited, including the Leicester, Cotswold, Southdown, Shropshire, Hampshire, Cheviot, and Blackfaced. We need not detain the reader with a description of these breeds, so well known to him, and specimens of which can be seen at our principal agricultural shows. We may simply mention, that all the different breeds were well represented, as the names of Sanday and Turner in Leicesters; of Jonas Webb and Rigden in Southdowns; of Bryden, Elliot, and Borthwick in Cheviots; and of Blackstock and Stewart in Blackfaced, as exhibitors and prize-takers will testify. To this division belong also the Dutch, Texel, and Holstein sheep. The Texel sheep are

large well-shaped animals, gross in appearance, indicative of the rich pastures and moist climate in which they have been fed, viz. the drained lakes of Holland. One of the largest shearling sheep in the exhibition was a ram born in Texel, but reared in Purmerend, a drained lake in Holland, of great fertility. They evince a great aptitude to fatten. The Holstein sheep resemble these much in appearance. Those exhibited were reared on the Polders, and excited a good deal of attention, from a very large ram, and six ewes nursing twenty-one lambs, being of the number. They are, I believe, distinguished for their great fecundity.

The second division includes entirely the Merino breed. This was a most interesting part of the Exhibition to those unaccustomed to merinos. Kept entirely for their wool, everything in their appearance has been made to give place to this. We find them, therefore, to be coarse ill-shaped animals, the very reverse of our Leicesters in symmetry. We had specimens of them from those countries now most distinguished for the breed, Austria, Saxony, and France. Spain had no direct representatives. We have little conception in this country of the great value which is attached to those sheep on the Continent, and of the great attention which is paid to their breeding. No stock of short-horns or Leicesters in this country can boast of a better pedigree, or be referred back to a particular celebrated sire or dam, with greater accuracy than some of the flocks of merinos on the Continent. In most of the breeding establishments attached to the flocks, registers are kept, in which are noted down the genealogies of the rams and ewes. Nor should we be astonished at this, when we know that their wool is the principal source of income of many foreign noblemen who possess numerous flocks of them. An anecdote is related, that a noble duke, of large possessions in the south of Scotland, once told a foreign nobleman, well known in political circles, the probable number of the sheep which grazed on his hundred hills; "that," answered the foreigner, "is the number of my shepherds."

The merinos (both merinos common and merinos-negretti) are not an original breed, but are the results of repeated crossings between the native Spanish breed and one belonging to the ancient Romans. "The excellency of the merinos," says Mr Youatt, "consists in the unexampled fineness and felting property of the wool, and in the weight of it yielded by each individual sheep; the closeness of that wool, and the luxuriance of the yolk, which enables them to support extremes of cold and wet quite as well as any other breed; the easiness with which they adapt themselves to every change of climate, and thrive and retain, with common care, all their fineness of wool under a burning tropical sun, and in the frozen regions of the north; an appetite which renders them apparently satisfied with the coarsest food; a quietness and patience into whatever pasture they are turned, and a gentleness and tractableness not excelled in any other breed." They are

divided in the Exhibition into two classes, those of the high and those of the low country, differing from one another more in size and in the covering with wool than in anything else. The low-country sheep are considerably larger, and the wool covers their legs and their heads much more than it does those of the high country. The rams are all horned, the ewes generally without horns. The sheep generally are coarse-headed and Roman-nosed. The average weight of the fleeces of the Austrian merinos, of which we had specimens in the Exhibition, is almost $1\frac{5}{8}$ lb., which, with wool at 3s. per lb., the mean price, we are told in a note, would be worth 5s.

Of the other native breeds shown, we may mention the Piémontais, a very large sheep, in shape resembling the merino, but very coarse in the wool, and the Cauchois, Normande, Barbarin, Lorraine, and Limousine, all native breeds of France, the first four very coarse, the latter somewhat resembling our Cheviots.

The show of Swine was not as good as is often seen in this country at the exhibitions of the principal Agricultural Societies. Indeed, the finest animals were either the property of Englishmen, or bred by them and sold to the French, and most of our improved breeds were represented. Of the French races we had the Normande, the Craonnais, the Manceau, all coarse animals, large, bony, thin in the back, flat in the sides, with very long hanging ears. Austria exhibited animals of the Szalonta and Mangalicza breeds, which appear scarcely to have emerged from the wild state. They are black, with thin coarse hair, tending to curl; leggy, round, and narrow-backed and flat-sided. These were the principal breeds exhibited; and perhaps there was no department of the Exhibition which showed more clearly the superiority of British agriculture than that of the pigs. The whole appearance of the English breeds indicated a higher state of civilisation (if we may be allowed the expression as applied to pigs), than that of their foreign congeners; for it is impossible that animals of such symmetry and fineness of constitution could remain long in such a climate as that of England and retain their great perfection, unless they were subjected to the most artificial treatment. The Continental breeds, coarse as they are, compelled, under the present system of agriculture, to go and search for their food in the fields and woods, are of more use there than some of our improved breeds, which can do nothing but lie and eat the food which is brought them, however profitable they may be to their owners under this system. But still the former may be improved considerably, as is evident from some crosses exhibited between the English breeds and the Normande and Craonnaise. They appeared to be such animals as a farmer in this country would like to have, not requiring too much care from him, but at the same time proving most profitable under judicious management. They were a combination of size and fineness, somewhat larger than the New

Leicester, but not quite so fine. In no branch of the improvement of domestic animals has the skill of our breeders obtained a greater triumph than in the breeding of swine; for they have certainly produced living machines, which attain the object required of them (viz. the conversion of their food into flesh) at the least possible expense. And this is the more apparent when they are contrasted with the ungainly-looking brutes by which they were surrounded in the Exhibition.

Immediately to the west of the building were erected sheds and houses for animals, many of which were useful, while others were regarded, by the most part of the spectators, more as zoological curiosities. Here were found goats and rabbits of many different breeds; the zebu, or Indian bull, and cow, so useful as a beast of burden in its native country, with the peculiar hump on its back, so much esteemed as a delicacy by epicures; the llama, so valuable to the ancient Peruvians for its tractable disposition as a beast of burden, and now so much prized for its hair, which is of a woolly nature; the American deer, and others. In this section, in short, we found, in the coverings of the different animals exhibited, the gradations from the coarse hair to the fine wool, which appear to have met in one case, that of the Angora goat. The poultry were also placed in this quarter, and attracted considerable attention from the ladies and mere sightseers. The show of them was very extensive, and comprised a greater variety than I ever witnessed at any exhibition. Specimens of all the kinds usually shown in this country were to be found there, with considerable additions from the native breeds of France. We have seen better birds of those kinds which are reared for competition in this country than any exhibited at Paris; but there are some of the native breeds of France, such as that of the crève-cœur, which, from their good shapes and size, might be most advantageously introduced into this country, to be used for crossing with some of our breeds. Ducks, turkeys, and geese, completed this part of the Exhibition; while pigeons and pheasants of great variety, and guinea-fowls, added much to the brilliancy of the scene, by the beauty and splendour of their plumage.

In a country wholly or principally dependent upon its own internal resources for the food of its people, agriculture must ever demand the first exercise of their labour. A full proportion of labour must always be given to it, whatever else may be required for the other branches of industry. The smaller, therefore, the number required in agriculture to raise the same quantity of produce, the larger will be the surplus for employment in the other occupations which add to the wealth of a country. Now, the principal means of accomplishing this economy of human labour are the exercise of skill and the employment of machinery, both of which indicate a high state of advancement in the arts. The profitable use of machinery in agriculture, then, may be regarded as a true test of its progress. The savage does not know how to apply

his labour for raising food for himself, but depends upon the spontaneous products of the soil for a scanty and uncertain substitute. An individual of those races, but one stage removed from barbarism, is able barely to maintain himself from the produce of the ground, which he scratches with the rudest implements. The nations farther up in the scale of civilisation call in the aid of the labour of animals, by which means, and more improved implements, the labour of one man is sufficient to produce food for more than himself. And when we come to those countries where agriculture has made the greatest progress, where science has been applied, skill has been employed, and implements have been improved so as to encourage labour, one man becomes the producer of food for several consumers.

If we are to judge of the agriculture of the different countries which exhibited implements at Paris by the criterion stated above, we must assign the first place to that of England. The machines and implements exhibited by it, possessed in construction a solidity, in workmanship an excellence, in design an adaptation to the requirements of an improved system of farming, which did not characterise those from other countries in such a marked manner. On the contrary, many of the latter were very slight in their construction, as was evidenced by the explosion of one of the locomotive boilers, and by the issuing of steam through the bolt-holes of others. Their thrashing-machines, with but few exceptions, were of the simplest kind, divested of winnowing-machines, and of those other parts of machinery considered so necessary for the economy of labour on a well-conducted farm. In one case there was rather a novel application of motive power on the treadmill principle to a thrashing-machine: a horse is made to walk on a platform of wood, on which is an endless series of steps, through which, as his feet press upon them, motion is given to the platform, and thus conveyed to the machinery. If animals could be got to walk quietly on the platform, the application of this principle could be turned to many useful purposes in the steading.

When we state that there was nothing new in principle in the machine and implement department, that the collections from England were decidedly the best, and that we have often seen a better show of them in this country, we need not detain our readers by any minute description. We will therefore proceed to mention a few things which attracted our attention in our survey of this portion of the Exhibition. The foreign ploughs struck us as being very clumsy in construction, and devoid of all attention to scientific and mechanical principles in the form and combination of the parts. Howard's plough, which carried off the first prize at the Berwick show, obtained here also the first prize. The same remarks cannot apply to the carts; they appeared to be most serviceable vehicles. There were several reaping-machines exhibited, constructed after the fashion of those which competed at the great show last year. There was one shown which was wrought by being pushed by the

hand. The principle of it was very much the same as Smith of Deanston's, the cutter being a circular revolving blade, from the axis of which, extending up to the height of the crop, radiated small pieces of iron or arms for throwing the cut grain aside. A large machine on the same principle for horses was also shown. We were also struck with the great number of machines which were exhibited for raising water, principally for the purposes of irrigation. We were led to suppose from them that this subject was exciting a good deal of interest. There was also shown a model of a new method of applying water as a motive power, in which the water set the machine in motion by falling alternately into two buckets joined to one another, like the two sides of an equilateral triangle, and made to oscillate at the apex. This certainly appeared far more simple than a large cumbersome wheel. It was invented by M. Dubuc. A machine, or rather machines, for making straw mats for the preservation of vines, potatoes, and other plants from spring frosts, is deserving of notice. The whole machinery can be purchased for little more than £3 sterling, by which the straw is cut to the required length, and bound firmly together by wire. The mats are said to last for four years. They are of more use in gardens or on small farms near towns, where early potatoes are raised, than they will be on an extensive farm. There was also shown a machine invented for ventilating grain laid up in granaries, by causing a current of air to pass through porous pipes placed in the bottom of the heap of grain; it will be of very great benefit in warm countries, where the grain is liable not only to heating, and acquiring a musty smell, but also to the attack of insects. We cannot omit to mention a portable machine, composed of a straw-cutter and turnip-grater, and a box for the cut straw and grated turnip to fall into and be mixed. It is constructed so that both of the machines can be driven at once or separately, as desired, by the hand or machinery. The cost of it is about £7. We allude to it principally to show the importance which is attached on the Continent, in the feeding of cattle, to the mixing of roots with cut straw, a practice which we would like to see more generally followed in this country, and which we hope to see become ere long as much the rule as it is at present the exception.

The exhibition of produce was both extensive and instructive. We had interesting collections of the produce of Great Britain and Ireland, amongst which, we may mention, was found the best sample of wheat in the Exhibition, viz., that from Linplum, which is situated in the high district of Haddington. The variety was Brodie's, and it was spring grown. We had also specimens of the produce of almost every country in Europe, so that we had an opportunity of studying in some measure the peculiarities of cultivation which climate and other adventitious circumstances had compelled the farmers of the different countries to adopt. While

in one place we had the results of the vine cultivation, in another we had specimens of the fine merino wool from sheep on the Alps in all stages of preparation. France, as was to be expected, made great exertions to have this part of the Exhibition as extensive and interesting as possible. Most of the local agricultural societies, and all the imperial agricultural schools, made collections of the different substances produced in their districts, and also the manufactured article from these products, thus presenting at a glance the agricultural, and no small part of the manufacturing wealth of France. Her colonies sent up also interesting collections of their produce, among which that of Algiers was decidedly the first. Few but those who have either seen such a collection, or visited the country itself, have any idea of the wealth of this colony.

The question has often been asked, What practical benefit have we derived, or can we derive, from the Paris Exhibition of Agriculture? A ready answer could be given to this by saying, that from all such exhibitions good must result to the parties concerned, by their being enabled either to copy what is excellent or avoid what is faulty, and by bringing together men of different tastes, and habits of thought, so necessary to a healthy tone of mind. But in so far as this country is concerned, an answer more to the point may be given; for if we take a pecuniary view of the matter, we will find most substantial benefits have accrued to the country, both in the numerous money-premiums and medals which have been awarded to the exhibitors, and in the very handsome prizes which have been given for the majority of the stock sent over. Besides, an important market has been opened up for British stock, which it will take many a year to glut, if the stock be found to answer. Certainly few breeders need be dissatisfied with the favourable opportunity afforded them of exhibiting their stock to purchasers from all parts of Europe. The stock sent over was, 42 bulls, 96 cows and 9 calves, 174 sheep, and 16 lambs. There have been returned to Scotland 34 cattle and 141 sheep. Most of the stock was sold in Paris, some in London, and a few died. There could not have been realised from sales and premiums by the Scotch exhibitors less than L.10,000.

We would not advise any tampering with our improved native breeds by the introduction of foreign blood. Let our Ayrshires retain their elegance, gracefulness, and excellent milking properties; let our Durhams retain their majestic gait, precocity, and aptitude to fatten; let our Leicesters and southdowns retain their perfect symmetry; let our Cheviots and blackfaced lose not their hardiness. From anything we saw, they cannot be improved by the amalgamation of foreign blood. The experiment would be dangerous. But it must be admitted that the pure breeds are not, under all circumstances of British farming, the most profitable; the crosses are often most important and valuable. It is well known that in London a cross with the improved short-horn and a cow

from a breed valued for its milking qualities is preferred by dairy-keepers to a cow of the pure milking breed, because, when it is of no further use for giving milk, it is more easily fattened off, and attains a greater weight than the latter. Now, it becomes a question if, in circumstances such as that, and even in country districts, where the rearing of large cattle for feeding is an object with the farmer, the introduction of some Flamande cows may not be advantageous; for there is no milky breed with which we are acquainted better adapted for throwing a good cross with an improved short-horn than the Flamande. The Swiss cattle were in high repute with many Englishmen, and one nobleman has purchased 14 of them to bring over to this country. We have already expressed a favourable opinion of them as milkers, though they are rather coarse; but as we are not aware of the purpose for which they have been introduced—whether to be retained as a pure breed or merely for crossing—we are unable to express an opinion as to the policy of the step. Perhaps they might improve the milking properties of some of the breeds of the south of England, to which they are somewhat similar in appearance, though possessing better points as milkers. There are circumstances, too, where a judicious cross might be had between the Ayrshire and Breton, a beautiful specimen of which was shown in the Exhibition. The same remarks apply to sheep. The Texel and Holstein sheep, from their size and other good qualities, would throw capital stock with an improved Leicester, in which there are often complaints of the want of weight.

One of the most interesting and instructive parts of the Exhibition was that devoted to the crosses. And here we observed the favour in which the improved short-horns were held, from the numerous crosses which bore their characters. Those between the short-horns and the Cotentine, the Flamande, the Manceau, the Dutch, and the Charolaise, are particularly worthy of notice, and show in a marked manner what agricultural wealth would accrue to France if the farmers, directing more attention to the production of beef, would raise first crosses with a short-horn bull and some of their native cows. The cross between the short-horn bull and Breton cow, of which there were several examples in the Exhibition, was very like the pure Holland cow, but with a greater tendency to lay on fat. Some of the crosses between the native breeds, such as the Normande and Flamande, were very large—the largest cross, in fact, shown. We cannot help thinking that the French are committing an error in breeding too much from crosses. The first crosses are good, but to breed from them will be attended with some risk, unless the object is to give a dash of one particular breed to another, which must be done with great care for successive generations. From the purchases made of Ayrshire stock by the foreigners, the production of milk seems to be a more important object with them than the production of beef. It was

observed that there were more cows in proportion bought, than bulls for breeding purposes. If the object of the foreign buyer is simply to amalgamate the blood of the Ayrshire with that of his native breed, to ingraft its good milking qualities on the original stock, without depreciating its own peculiar properties, particularly its fitness for labour, we think that he has done right in purchasing cows in preference to bulls. The present fashionable breed of short-horns is descended from a Galloway cow; and in the same way the distinctive characters of the native breeds may be maintained, while some of the excellent points of the Ayrshire may have been imparted to it. We would most willingly have enlarged on this subject had our time and space permitted.

Before drawing these notes to a close, we must express our acknowledgments to the French Government, which we are sure are shared in by all the Scotch visitors, for the opportunity they have afforded us of witnessing the grand agricultural spectacle just brought to a conclusion at Paris. And we must express our high admiration of that feeling in them which prompted the awarding of premiums and medals to the servants who had charge of the stock exhibited, in addition to the very handsome liberality which they showed in the management of the Exhibition generally. If it be the case that the state of agriculture in France required such great exertions to be put forth in behalf of it, it must be admitted that it is not only highly creditable to those who perceived it, devised the scheme of the Universal Exhibition, and carried it into execution, but it is the best thing that could have been done for the progress of agriculture in France. For to know one's deficiencies, to acknowledge one's errors, is the first step towards improvement.

We do not deny that we are unrivalled in our agriculture; but we have seen enough to let us know that we can adopt with advantage something connected with agriculture in France—such as her educational establishments. And we ought not to forget that we are far more advantageously situated here, both from the markets which we command, and from our political institutions. Every revolution which occurs in a country throws back its agriculture; and the present system of the division of property among children on the death of a parent which prevails in France impedes its progress. If we are first at present in the race of agricultural progress, we must remember that we are deprived of that stimulus of rivalry which pervades those behind us. In these times of rapid changes, we require to be awake, to brace up our energies to keep pace with the improvements which are going on around us. A discovery new to-day is succeeded by one more wonderful to-morrow; an invention considered perfect this week, is displaced by one more extraordinary in its results the next. As in the unceasing roll of waves, which appear for a little, and then are lost for ever on the beach, so, in the multitude of improve-

ments which rise around us every day, our attention is attracted by them, as they pass before us in rapid succession, to be forgotten, as they are ever displaced by those that follow. Let us, therefore, not relax our energies; for we may be sure that many countries will date an improvement in their agriculture from the Paris Universal Agricultural Exhibition.

FIARS PRICES of the different COUNTIES of SCOTLAND, for Crop and Year 1855, *by the Imperial Measure.*

ABERDEEN.

	Imp. qr.
Wheat	69/2
Barley, without fodder	37/1
——— with fodder	43/7
Bere, First, without fod.	37/3
——— with fodder	43/9
—— Second, without fod.	35/9
——— with fodder	42/3
Oats, Potato, without fod.	27/2
——— with fodder	35/2
— Common, without fod.	26/2
——— with fodder	34/2
Pease	39/
Beans	32/10
Malt, duty included	66/4
Oatmeal, per 140 lb.	22/

ARGYLL.

Wheat	72/2
Barley	39/10
Bere	37/2
Oats	28/2
Beans	43/2
Oatmeal, per 140 lb.	22/

AYR.

Wheat	67/4½
Barley	37/7
Bere	33/4¾
Oats	23/
Pease	
Beans	48/
Oatmeal, per 140 lb.	21/0½

BANFF.

Wheat	77/6
Barley, without fodder	37/6
——— with fodder	42/
Bere, without fodder	34/3
—— with fodder	38/9
Oats, Potato, without fod.	26/9
——— with fodder	32/3
— Common, without fod.	26/4
——— with fodder	31/10
Pease	38/
Beans	39/10
Rye	
Oatmeal, per 140 lb.	21/3

BERWICK.

Wheat	75/1$\frac{3}{12}$
Barley, Merse	37/3
——— Lammermuir	39/4
Bere	29/11$\frac{11}{12}$
Oats, Merse	29/8
—— Lammermuir	30/3$\frac{6}{12}$
Pease	43/0$\frac{2}{12}$
Oatmeal, per 140 lb.	23/10$\frac{3}{12}$

BUTE.

	Imp. qr.
Wheat	70/0¾
Barley	41/1
Bere	33/10½
Oats	26/9
Pease and Beans	43/3
Oatmeal, per 140 lb.	21/6¾

CAITHNESS.

Barley	34/9¾
Bere	31/3¾
Oats, Angus	24/6¾
—— Sandy	
Oatmeal, per 140 lb.	20/2¾

CLACKMANNAN.

Wheat	65/10½
Barley, Kerse	39/
——— Dryfield	41/2¾
Oats, Kerse	28/6
—— Dryfield	27/11¼
Pease and Beans	43/10¼
Malt, duty free	47/11¾
Oatmeal, per 140 lb.	22/0½

DUMBARTON.

Wheat	68/6
Barley	38/
Bere	36/
Oats	27/5
Pease and Beans	44/7
Oatmeal, per 140 lb.	22/6

DUMFRIES.

Wheat	71/6
Barley	39/10
Bere	
Oats, Potato	27/2
—— White	25/10
Rye	49/2
Pease	
Beans	50/
Malt	88/
Oatmeal, per 140 lb.	21/0½

EDINBURGH.

Wheat, First	70/9
——— Second	68/
Barley, First	40/6
——— Second	38/
——— Third	36/
Oats, First	29/6
—— Second	27/6
Pease and Beans	45/
Oatmeal, per 112 lb.	17/
——— 280 lb.	42/6

ELGIN AND MORAY.

	Imp. qr.
Wheat	78/2
Barley	40/9
Oats	29/4
Rye	43/5
Pease and Beans	48/10
Oatmeal, per 112 lb.	18/5

FIFE.

Wheat, White	73/3$\frac{4}{12}$
——— Red	68/8$\frac{4}{12}$
Barley	39/4
Bere	32/8$\frac{11}{12}$
Oats	28/9$\frac{4}{12}$
Rye	40/1$\frac{11}{12}$
Pease and Beans	40/2$\frac{11}{12}$
Malt	74/10$\frac{1}{12}$
Oatmeal, per 112 lb.	18/1$\frac{9}{12}$

FORFAR.

Wheat	74/3
—— Red	68/8
Barley	37/11
Bere	35/4
Oats, Potato	28/4
—— Common	28/11
Rye	45/10
Pease and Beans	39/2
Malt	74/10
Oatmeal, per 140 lb.	18/1

HADDINGTON.

Wheat, First	84/11
——— Second	78/3½
——— Third	71/10½
Barley, First	45/1½
——— Second	42/3
——— Third	38/10¼
Oats, First	35/2
—— Second	32/7½
—— Third	30/

INVERNESS.

Wheat, without fodder	77/
——— with fodder	84/
Barley, without fodder	39/7
——— with fodder	45/7
Bere, without fodder	37/7
—— with fodder	43/7
Oats, without fodder	28/7
—— with fodder	36/7
Rye, without fodder	37/6
—— with fodder	44/6
Pease	42/
Pease, with fodder	52/
Beans	46/
Oatmeal, per 112 lb.	18/11

FIARS PRICES—*Continued.*

KINCARDINE.

	Imp. qr.
Wheat, without fodder	74/6
—— with fodder	83/6
Barley, without fodder	37/4
—— with fodder	44/10
Bere, without fodder	35/4½
—— with fodder	42/10
Oats, Potato, without fod.	28/6½
—— with fodder	37/6
—— Common, without fod.	27/0½
—— with fod.	36/
Pease, without fodder	37/
—— with fodder	46/
Beans, without fodder	37/
—— with fodder	46/
Oatmeal, per 140 lb.	21/9¾

KINROSS.

Wheat	62/6
Barley, First	38/6
—— Second	36/8
Bere, First	
—— Second	
Oats, First	28/4
—— Second	26/8
——Black, First	
—— Second	
Pease	
Beans]	
Oatmeal, per 280 lb.	43/2

KIRKCUDBRIGHT.

Wheat	71/8
Barley	37/4
Oats, Potato	25/6
—— Common	
Beans	50/2
Oatmeal, per 140 lb.	20/5

LANARK.

Wheat, First	68/2
—— Second	61/5
—— Third	51/7½
Barley, First	39/10
—— Second	26/8
—— Third	24/1½
Bere, First	33/1½
—— Second	
Oats, First	27/2
—— Second	25/8½
Pease, First	
—— Second	
Beans, First	49/3
—— Second	45/2
Malt, duty free	53/4
Oatmeal, First, per 140 lb.	21/9
—— Second, do.	

LINLITHGOW.

Wheat	68/8
Barley	40/7
Oats	27/1
Pease and Beans	43/2
Malt	72/7
Oatmeal, per 140 lb.	21/9
—— 112 lb.	17/6

NAIRN.

	Imp. qr.
Wheat	78/
Barley, without fodder	40/8
—— with fodder	48/
Oats, without fodder	30/5
—— with fodder	42/
Oatmeal, per 112 lb.	19/3

ORKNEY.

Malt, per 140 lb.	15/5
—— with duty	27/3
Bere, per 380 lb.	16/9
Oatmeal, per 140 lb.	26/6

PEEBLES.

Wheat, First	72/7
—— Second	67/3½
—— Third	62/9
Barley, First	40/0¾
—— Second	37/9¾
—— Third	33/5¼
Oats, First	28/11½
—— Second	26/9¾
—— Third	24/6
Pease and Beans, First	53/
—— Second	46/7
—— Third	44/2
Oatmeal, per 140 lb. First	23/5
—— Second	22/
—— Third	20/

PERTH.

Wheat, First	72/1
—— Second	63/5
Barley, First	38/8
—— Second	34/5
Oats, First	27/9
—— Second	26/3½
Rye	43/
Pease and Beans	42/1
Oatmeal, per 140 lb.	22/8

RENFREW.

Wheat, First	69/0½
—— Second	67/7
Barley, First	38/2
—— Second	35/8
Bere, First	37/4
—— Second	
Oats, First	28/9½
—— Second	27/5¾
Beans, First	46/5
—— Second	45/11½
Oatmeal, per 140 lb. First	21/3

ROSS AND CROMARTY.

	Imp. qr.
Wheat, First	77/2
—— Second	76/10
Barley	40/11
Bere	40/
Oats, First	30/11
—— Second	28/
Pease	38/6
Beans	41/
Rye	41/8
Malt, duty free	42/5
Oatmeal, per 140 lb.	24/6
Barley-meal	21/4

ROXBURGH.

Wheat	75/4
Barley	37/10$\frac{6}{12}$
Oats	30/1$\frac{1}{12}$
Rye	
Pease	49/8$\frac{2}{12}$
Beans	47/0$\frac{8}{12}$
Oatmeal, per 140 lb.	22/8$\frac{6}{12}$

SELKIRK.

Wheat	71/6
Barley	37/7
Oats, Potato	28/6
—— Common	27/7
Pease	51/6
Oatmeal, per 280 lb.	41/6

STIRLING.

Wheat	61/4
Barley, Kerse	38/10$\frac{8}{12}$
—— Dryfield	38/5$\frac{4}{12}$
Oats, Kerse	27/6$\frac{8}{12}$
—— Dryfield	27/
—— Muirland	
Beans	45/
Malt	74/
Oatmeal, per 140 lb.	21/

SUTHERLAND.

Wheat	75/2
Barley	41/6
Bere	30/
Oats	30/11
Rye	
Pease	
Oatmeal, per 140 lb.	24/8

WIGTOWN.

Wheat	67/8
Barley	38/
Bere	34/8
Oats, Potato	24/8
—— Common	
Rye	40/
Pease	
Beans	43/8
Malt	
Oatmeal, per 280 lb.	40/2

We may inform our English readers, that Fiars Prices are the average prices of grain, as ascertained every year, by the verdict of Juries, in every County of Scotland. The Juries are summoned in spring, and ascertain, from the evidence produced to them, the average prices of the preceding crop. By these prices, rents payable in grain, and similar contracts, are generally determined; but the main object is to convert into money the stipends (for the most part fixed at a certain quantity of grain) of the Scottish Clergy.

AVERAGE PRICE OF THE DIFFERENT KINDS OF GRAIN,

PER IMPERIAL QUARTER, SOLD AT THE FOLLOWING PLACES.

LONDON.

Date.	Wheat.		Barley.		Oats.		Rye.		Pease.		Beans.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 2.	78	3	39	3	26	0	53	0	45	9	41	6
9.	76	8	38	3	24	6	52	6	45	11	40	1
16.	72	4	37	7	21	8	50	4	43	6	38	6
23.	70	10	35	10	23	8	48	10	41	0	39	8
Mar. 1.	72	2	36	4	22	7	47	4	40	2	37	8
8.	72	4	35	5	24	9	46	5	39	10	38	11
15.	68	7	37	5	21	11	44	6	40	11	38	7
22.	69	2	38	2	22	4	42	2	39	7	36	11
29.	72	6	37	6	21	3	43	10	40	5	38	6
April 5.	71	8	39	1	21	10	46	0	40	6	39	1
12.	71	2	38	4	23	5	42	2	38	9	38	9
19.	71	6	40	1	21	5	41	8	36	9	38	5
26.	69	5	38	7	21	8	40	6	39	0	38	5
May 3.	68	6	39	8	21	11	36	11	37	10	40	2
10.	70	5	38	3	21	8	38	0	38	4	34	9
17.	72	2	40	6	23	2	38	2	41	7	37	5
24.	69	4	38	0	21	11	38	6	36	4	38	1
31.	71	9	37	5	22	2	38	7	43	4	39	4

LIVERPOOL.

Date.	Wheat.		Barley.		Oats.		Rye.		Pease.		Beans.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 2.	74	10	37	0	26	10	41	6	46	11	42	0
9.	72	9	39	10	26	6	40	8	44	9	46	3
16.	67	10	33	8	29	3	38	6	43	6	43	5
23.	67	2	36	5	21	10	35	3	42	4	39	11
Mar. 1.	67	5	35	4	23	5	36	2	41	6	43	7
8.	67	8	37	2	24	8	37	4	41	10	41	10
15.	67	9	35	5	21	7	38	6	42	1	43	10
22.	68	4	37	9	23	11	40	4	42	6	44	7
29.	69	4	37	4	25	10	43	7	42	4	43	5
April 5.	68	7	36	9	24	8	44	6	42	0	43	7
12.	68	8	36	5	23	9	42	10	42	4	44	6
19.	68	0	36	9	24	6	40	6	43	2	45	2
26.	68	1	38	3	22	8	38	9	42	2	41	4
May 3.	67	2	38	6	21	6	40	6	41	9	44	7
10.	69	1	38	9	23	8	42	4	40	3	45	5
17.	70	0	34	3	23	9	45	2	39	6	41	5
24.	69	6	33	7	23	8	43	4	38	8	44	6
31.	68	6	33	0	22	4	42	8	39	2	44	5

EDINBURGH.

Date.	Wheat.		Barley.		Oats.		Pease.		Beans.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 6.	64	2	34	8	26	9	44	0	44	7
13.	65	0	34	7	27	2	42	6	43	1
20.	68	6	35	8	29	1	44	2	44	11
27.	71	1	36	9	30	2	45	9	47	1
Mar. 5.	67	3	37	6	32	2	45	10	46	5
12.	69	11	41	4	33	1	47	2	48	3
19.	72	11	41	1	33	5	46	2	46	10
26.	68	11	40	4	30	9	44	6	45	3
April 2.	70	1	40	10	30	1	44	10	45	7
9.	72	0	41	6	30	1	44	4	45	2
16.	69	3	40	8	29	1	43	6	44	5
23.	68	2	40	3	28	5	43	4	44	3
30.	68	11	40	11	28	8	43	8	44	6
May 7.	68	11	40	8	27	10	43	6	44	9
14.	67	10	40	7	28	5	44	6	45	9
21.	67	3	40	9	27	11	44	8	45	3
28.	67	4	39	11	28	8	42	6	43	2

DUBLIN.

Date.	Wheat, p. barl. 20 st.		Barley. p. barl. 16 st.		Bere, p. barl. 17 st.		Oats, p. barl. 14 st.		Flour, p. barl. 9 st.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 8.	37	0	18	6	17	1	13	8	25	8
15.	38	6	18	7	16	9	13	4	25	10
22.	38	9	18	11	16	11	13	7	26	4
29.	38	6	18	9	16	8	13	5	26	6
Mar. 7.	38	2	18	6	16	4	13	6	26	4
14.	37	11	18	4	16	2	13	8	26	3
21.	37	10	18	3	15	11	13	4	26	2
28.	38	0	18	1	16	1	13	6	26	0
April 4.	38	3	18	0	15	10	14	2	26	2
11.	39	11	19	1	16	6	14	6	26	4
18.	39	8	19	2	17	1	14	3	26	6
25.	39	10	19	0	17	3	14	2	26	7
May 2.	39	8	19	2	16	10	14	3	26	5
9.	39	6	19	1	17	2	14	1	26	4
16.	39	9	19	2	17	3	14	0	26	3
23.	40	6	19	4	16	11	13	6	26	6
30.	41	10	19	6	17	4	13	9	26	10

TABLE SHOWING THE WEEKLY AVERAGE PRICE OF GRAIN,

Made up in terms of 7th and 8th Geo. IV., c. 58, and 9th and 10th Vict., c. 22. On and after 1st February 1849, the Duty payable on FOREIGN CORN imported is 1s. per quarter, and on Flour or Meal 4½d. for every cwt.

Date.	Wheat. Weekly Average.		Wheat. Aggregate Average.		Barley. Weekly Average.		Barley. Aggregate Average.		Oats. Weekly Average.		Oats. Aggregate Average.		Rye. Weekly Average.		Rye. Aggregate Average.		Pease. Weekly Average.		Pease. Aggregate Average.		Beans. Weekly Average.		Beans. Aggregate Average.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Feb. 2.	75	10	76	6	38	6	38	6	25	5	26	3	53	2	53	8	43	1	45	3	44	5	46	5
9.	73	8	75	11	37	5	38	2	24	6	25	10	51	4	53	1	42	2	44	4	43	4	45	6
16.	71	7	75	1	37	2	37	11	23	10	25	4	50	4	52	9	41	6	43	5	42	7	44	8
23.	69	2	73	11	35	8	37	6	23	6	24	11	45	4	51	4	39	6	42	5	41	7	43	10
Mar. 1.	69	7	72	9	35	6	37	0	23	9	24	5	47	2	50	4	39	5	41	6	41	5	43	1
8.	69	11	71	7	35	11	36	8	24	1	24	2	46	6	49	0	40	3	41	0	40	10	42	4
15.	67	11	70	4	36	3	36	4	23	2	23	10	43	2	47	4	40	3	40	6	41	0	41	10
22.	67	5	69	3	37	2	36	3	23	2	23	7	43	5	46	0	39	6	40	1	40	7	41	4
29.	69	10	69	0	38	1	36	5	24	0	23	7	46	5	45	4	40	1	39	10	41	3	41	1
April 5.	69	5	69	0	38	8	36	11	23	6	23	7	44	7	45	3	39	7	39	10	40	7	40	11
12.	68	7	68	10	39	8	37	6	23	8	23	8	42	4	44	5	37	10	39	7	41	4	40	10
19.	69	0	68	8	39	2	38	1	23	7	23	6	44	7	44	1	37	4	39	1	41	9	41	1
26.	67	11	68	7	39	11	38	8	23	4	23	7	40	3	43	7	39	2	38	11	41	4	41	2
May 3.	66	6	68	7	40	5	39	3	22	9	23	6	38	11	42	10	39	0	38	10	41	11	41	4
10.	67	7	68	2	40	3	39	7	23	10	23	5	43	7	42	4	38	5	38	7	41	3	41	4
17.	68	9	68	1	40	0	39	10	23	5	23	5	41	4	41	10	39	11	38	6	41	7	41	6
24.	69	2	68	2	39	6	39	11	23	10	23	6	47	6	42	8	38	8	38	9	41	6	41	6
31.	68	2	68	0	38	11	39	10	23	10	23	6	42	4	42	4	39	11	39	2	42	2	41	7

FOREIGN MARKETS.—Per Imperial Quarter, free on board.

Date.	Markets.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1856.		s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Feb. ..	Danzig	70 6 - 76 0	27 6 - 32 6	18 6 - 24 0	42 6 - 51 0	40 0 - 48 6	38 6 - 47 0
March	Danzig	68 6 - 72 6	26 0 - 30 6	17 6 - 23 6	42 6 - 50 6	40 6 - 48 0	39 6 - 46 6
April..	Danzig	66 6 - 72 0	25 6 - 30 0	16 6 - 22 0	40 6 - 48 6	39 6 - 45 6	38 9 - 45 6
May ..	Danzig	64 0 - 70 6	24 0 - 28 6	16 0 - 21 6	38 6 - 45 0	36 6 - 43 6	37 6 - 44 0
Feb. ..	Hamburg	66 6 - 76 6	29 6 - 37 0	18 6 - 23 0	38 6 - 48 6	43 6 - 53 0	40 0 - 46 6
March	Hamburg	64 6 - 75 0	28 6 - 35 0	17 6 - 21 6	37 6 - 46 6	42 6 - 52 6	39 6 - 44 6
April..	Hamburg	60 6 - 66 6	27 6 - 32 6	17 0 - 20 0	35 6 - 45 0	40 6 - 50 0	38 6 - 42 6
May ..	Hamburg	60 0 - 65 6	26 6 - 32 0	17 6 - 20 6	34 0 - 44 6	38 6 - 46 6	37 6 - 41 6
Feb. ..	Bremen	60 6 - 69 0	28 6 - 35 0	18 6 - 22 6	43 6 - 50 6	39 6 - 44 6	35 6 - 44 6
March	Bremen	58 6 - 70 0	26 6 - 33 0	18 0 - 21 6	42 0 - 48 6	38 0 - 43 6	33 6 - 42 0
April..	Bremen	57 6 - 68 6	25 6 - 28 3	18 6 - 22 0	40 0 - 46 6	37 6 - 42 6	31 6 - 35 6
May ..	Bremen	56 6 - 68 0	24 6 - 28 0	17 6 - 20 6	38 0 - 44 0	36 0 - 40 6	30 6 - 35 0
Feb. ..	Königsberg	68 6 - 74 6	26 6 - 34 6	18 0 - 26 6	38 6 - 45 6	38 0 - 46 6	36 6 - 45 6
March	Königsberg	66 6 - 72 6	25 6 - 33 0	17 6 - 24 6	36 6 - 45 0	36 6 - 44 6	35 6 - 42 6
April..	Königsberg	66 0 - 70 6	24 6 - 31 6	16 6 - 21 0	35 6 - 43 6	37 6 - 47 6	30 6 - 35 9
May ..	Königsberg	65 6 - 68 6	24 0 - 30 6	16 0 - 20 6	34 0 - 42 6	35 6 - 44 6	31 6 - 36 6

Freights from the Baltic, from 4s. to 6s. 6d.; from the Mediterranean, 6s. 6d. to 12s. 6d.; and by steamer from Hamburg, 4s. to 6s. per imperial qr.

THE REVENUE.—From 31st March 1855 to 31st March 1856.

	Quarters ending Mar. 31.		Increase.	Decrease.	Years ending Mar. 31.		Increase.	Decrease.
	1855.	1856.			1855.	1856.		
	£	£	£	£	£	£	£	£
Customs	4,728,111	5,225,169	497,058	..	20,998,874	21,788,770	789,996	..
Excise	2,594,518	2,631,600	37,082	..	16,341,128	16,636,670	295,542	..
Stamps	1,822,239	1,766,463	..	55,766	7,132,949	6,894,307	..	238,642
Taxes	200,030	207,738	7,708	..	3,136,143	2,958,626	..	177,517
Post-Office ..	329,923	327,399	..	2,524	1,334,157	1,171,695	162,462	..
Miscellaneous	309,361	365,502	56,141	..	1,009,030	1,439,664	430,634	..
Property Tax	5,899,334	6,837,280	937,946	..	11,254,637	14,814,757	3,560,120	..
Total Income	15,883,516	17,361,151	1,535,935	58,290	61,206,918	65,704,489	5,238,754	416,159
	Deduct decrease....		58,290		Deduct decrease....		416,159	
	Increase on the qr...		1,477,645		Increase on the year		4,822,595	

PRICES OF BUTCHER-MEAT.—Per Stone of 14 Pounds.

Date.	LONDON.		LIVERPOOL.		NEWCASTLE.		EDINBURGH.		GLASGOW.	
	Beef.	Mutton.	Beef.	Mutton.	Beef.	Mutton.	Beef.	Mutton.	Beef.	Mutton.
1856.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Feb. ..	5 6 - 7 9	6 0 - 8 3	5 9 - 7 9	6 0 - 8 0	6 3 - 7 9	6 6 - 8 3	6 0 - 8 0	6 0 - 7 6	6 6 - 8 3	6 3 - 8 6
March..	5 9 - 7 9	6 3 - 8 3	6 0 - 8 0	6 3 - 8 3	6 3 - 7 9	7 9 - 8 9	6 3 - 8 0	6 3 - 7 9	6 9 - 8 6	6 9 - 8 9
April ..	6 0 - 8 0	6 6 - 8 6	6 3 - 8 3	6 6 - 9 3	6 0 - 7 6	7 6 - 8 6	6 6 - 8 6	6 6 - 8 6	6 9 - 8 9	7 0 - 9 0
May ..	6 6 - 8 6	6 9 - 8 9	6 6 - 8 6	6 9 - 9 6	6 6 - 8 6	7 6 - 8 9	6 3 - 8 3	6 0 - 7 9	6 6 - 8 6	6 6 - 8 6

PRICES OF ENGLISH AND SCOTCH WOOL.—Per Stone of 14 Pounds.

ENGLISH.	s. d. s. d.	SCOTCH.	s. d. s. d.
Merino, ...	16 0 to 24 0	Leicester Hogg, ...	17 6 to 21 6
.. in grease, ...	12 0 to 16 6	.. Ewe and Hogg, ...	14 6 to 19 6
South-Down, ...	18 6 to 20 6	Cheviot, white, ...	14 0 to 16 0
Half-Bred, ...	14 0 to 16 6	.. laid, washed, ...	10 6 to 13 0
Leicester Hogg, ...	16 6 to 21 0	.. .. unwashed,........	8 6 to 10 0
.. Ewe and Hogg, ...	14 0 to 18 6	Moor, white, ...	7 6 to 8 6
Locks, ...	8 0 to 10 0	.. laid, washed,...........	5 6 to 6 9
Moor, ...	6 0 to 7 6	.. .. unwashed,..........	4 9 to 5 9

SCIENCES APPLICABLE TO AGRICULTURE.

Although agricultural improvement has been comparatively of recent date, its progress has been most satisfactory. It was long before it was distinctly perceived from what quarters the most effectual aid was likely to be derived; and even when that discovery was made, there were many obstacles to its being rendered immediately available. Prejudices had to be overcome, inveterate habits abandoned, capital increased, and processes engaged in, which, like everything tentative and experimental, involved the risk of loss. But while the general body of agriculturists continued apathetic, and even, in not a few cases, deprecated change and treated it with ridicule, instances of an opposite kind were to be found in different parts of the country, where the means and desire for improvement were happily combined. These, exerted with energy and skill, soon led to important results, and showed so clearly what could be done for the improvement of the soil, that even the most incredulous could not fail to be convinced. Improved farms became objects of general interest, and formed centres from which useful information and the spirit of emulation were propagated through the land. With the improvement of education, or rather its extension (for of the former we have not much to boast), practical farmers acquired the power, of which they were formerly in a great measure destitute, of expressing their ideas, and embodying the results of their experience, in oral discussion and written reports. These, through the medium of the press and the active agency of agricultural associations, were given to the public, and, constituting at length a kind of agricultural literature, aided materially in exciting inquiry, and giving an impetus to the advancing movement. The aid of science was felt to be needed long before it was given, for it was late in entering the field, and slow in realising the advantages that were expected from it. It was even asserted, not many years ago, by one of the most zealous and intelligent agriculturists of the day, that chemistry, from which most was expected, had done nothing for the farmer, but in teaching him to use with greater advantage two kinds of manure formerly unprofitable. It has done much, however, since to remove this reproach, and we should be disposed to estimate the services chemistry has recently rendered, not so much by their intrinsic value, considerable though it be, as by the indications they afford of what it is yet able to accomplish. Connected with so many interests, and touching at so many points on the two great cycles of the arts and sciences, agriculture has drawn from these advantages more and more important in proportion as they themselves have advanced, and the tributary rills which swell the advancing

tide of improvement are derived from sources continually increasing both in number and copiousness.

It is easy to trace the outlines of this career of improvement, and to indicate the several circumstances which have exercised the most marked influence upon it. It has, of course, been often retarded or advanced, as in the case of the other arts, by circumstances external to itself, such as the state of legislation regarding it, the condition of the country, &c.; but there are certain things proper to agriculture itself, which may be regarded as marking eras or stages in its progress.—The verdant turf and natural fertility of limestone districts, compared with those where siliceous rocks and soil prevail, could scarcely fail to suggest, at an early time, the use of lime as a fertiliser, long before its mode of action was adequately understood. The pretty general distribution of limestone rocks, and the frequent occurrence of substances of the same, or of a similar nature, such as chalk, marl, &c., rendered it, though often expensive, for the most part accessible, and it has of late become much more so by means of railway conveyance. Its use is now almost universal, and as, among its many other good qualities, it is found to be the only antidote to a disease (finger-and-toe) which threatened at one time almost to put a stop to the cultivation of turnips, even in districts where that root forms perhaps the most valuable portion of their crops, it is becoming more and more indispensable. Its mode of action is even yet but partially understood; it appears to be far more complicated than is usually supposed. Its effects are well known; they are very striking—in some respects almost marvellous. It causes one description of vegetation to disappear—brings forth another and a more useful, even where, as in the case of white clover on heath-lands, the germ was not supposed to pre-exist; it so promotes maturity, that chiefly by its means the most upland and outlying districts where corn can be reared, are ready for harvest almost as soon as the alluvial lowland plains; it exerts, in short, such a genial influence on the whole conditions of vegetation, that it may be said to realise what was fabled of certain of the deities of antiquity, that wherever they set their foot new flowers sprung up, and wherever they went a fresher verdure marked their path.

Draining of a certain kind may almost be said to have been coeval with agriculture; for as lands superabounding with water would be at once found incapable of culture, open channels would naturally suggest themselves as an obvious means of remedying the evil. As land increased in value, and the expediency was felt of increasing the number of these channels or trenches, it was equally obvious that, by covering them over, they would still perform their office, while the space occupied by them would continue to be available for crop. And in this state draining continued,

modified by Elkington and others, till the introduction of furrow or thorough draining, which reached its present state of efficiency by the facilities afforded by machine-made tiles. The benefits of effective drainage cannot be over-estimated; it forms the basis of all agricultural improvement; for unless the land be properly dried, no mode of treatment, or kind of application, can exercise its full influence. If any cause of dispute still attach to the subject, it has no reference to its intrinsic merits, but merely to the mode of its execution; and much of that might be spared by the consideration that no one method is fitted for universal adoption, but that the practice must vary in different localities, according to the nature of the ground, the character of the subsoil, and a multitude of other considerations. A uniformity of system, under circumstances so diversified, would amount to a presumption against it.

By the operation just alluded to, the ground was prepared for another process, of no small moment in the progress of British husbandry, that of subsoil-ploughing. It may be said to present itself under two phases or modifications, that of simply stirring the soil to a considerable depth, including a stratum more or less deep of the subsoil, but leaving the latter unaltered in its relative position to the plant-bearing soil; and secondly, the Yester or Tweeddale system, by which the subsoil is not only broken up and agitated, but a portion of it is raised upwards and mixed with the surface-soil. Both practices provide for the more perfect aëration of the soil, and afford greater facilities for the development of the roots of plants, the escape of superfluous moisture, and the free action of manures; but the last-mentioned system, while it does all this even more effectually than the other, makes provision besides for increasing the depth of nutritive soil, by placing materials from the substratum in such a position that they mingle with and soon acquire the same properties as the upper soil, the whole forming in time a homogeneous mass, suited to the requirements of the deepest-rooted vegetation. Such a process, and the ingenious implements by which it is accomplished, well deserves to be signalised in the most cursory sketch of agricultural progress.

In no department has the condition of agriculture undergone greater change than in that of manures, especially that class of them named special manures. It is now nearly sixteen years since guano was first brought to this country, on the recommendation, we believe, of Liebig; the trial of a few barrels was sufficient to establish its reputation; and the golden eggs of the fabled goose were soon surpassed in value by the evacuations of sea-gulls! Notwithstanding its exorbitant price, the quantity imported amounted, in 1851, to no less than 243,014 tons; the amount, however, has since somewhat declined, probably owing to the

use of competing manures. In 1854, after a falling off in the two intervening years of nearly one-half the above-mentioned quantity, it again reached 235,111 tons; of which about 226,747 tons came from Peru, 3187 from British South Africa, 1502 from the United States, and 4249 from Chili. Other manures, resembling guano in energy, portability, and ease of application, have been in very general use, and their combined influence has been such as to give almost an entirely new complexion to some branches of husbandry. Of these, superphosphate of lime is perhaps the most important, and in its effect in quickening the growth of the young turnip-plant it is the only rival of guano, especially in districts where the climate is somewhat hot and dry. It is probably owing to this cause that, in the southern part of our island, it has been for some time, in some degree, superseding guano. Such has been the demand for it, that materials for its manufacture have been sought for in all quarters; even the rocky strata, where they have been entombed for untold ages, have been forced to give up their dead; and we now employ the relicts of the pre-Adamite world of animals to grow our crops, just as we have been accustomed to use the remains of its plants to cook our food and drive our machinery.

Some of the processes that have been referred to imply the existence of a very superior class of implements; and it is, indeed, impossible to glance at the progress of husbandry without observing how much it owes to the mechanical skill that has been exerted in its service. Fertility of invention and dexterity of execution are equally conspicuous; and we have only to compare our implements with those of foreign manufacture to perceive how much of our superiority is to be ascribed to this cause. In this department, accordingly, triumphs have likewise been achieved scarcely less notable than those already adverted to, and which may justly be regarded as indicating an era in the art. To advert to no others, it may be affirmed that reaping by machine is a matter virtually accomplished. Some time may elapse, and many experiments may be tried, before all the details be satisfactorily adjusted, and the implement rendered so thoroughly efficient as to drive every other competitor from the field, and come into common use. But this seems quite within the compass of its capabilities; and from the greatest difficulties being overcome, we may derive the assurance that the less important ones will yield to skilful and persevering effort.

The interest with which reaping-machines were lately regarded, is now transferred, in some measure, to the steam-plough, a matter apparently of greater difficulty, as it is one of still greater promise. Machines of this description are now in operation, and, from a subsequent notice, it will be seen what one of them has recently accomplished. It is a subject which, for some time to

come, will engross much of the attention of agriculturists. From observing what steam has already done in other departments—actually transforming the face of society and altering its most inveterate usages; from the consideration of its marvellous power and equally marvellous adaptability, by which it is alike fitted to spin a thread of gossamer, to propel a three-decker, or to wield, as we would a hammer, a mass of iron of a weight almost fabulous—high expectations are reasonably entertained of the advantages land-culture is to receive from it. It is a case deserving of its powers; an occasion such as the ancients thought worthy of the interference of a god. Something commensurate with what it has done in other instances will alone satisfy the public; where so much is expected, moderate success will be accounted a failure. And with more than moderate success the experiment has not, we fear, been hitherto attended; but even that is not without encouragements for the future; and we may indulge the hope that some comprehensive mind will find means of converting this mighty agent, more effectively than has yet been done, to the desired object, or that some fortunate accident, as sometimes happens in such cases, will disclose the means of doing it.

Such are a few of the improvements which agriculture has undergone, within a comparatively recent period, in one of her two great departments, that of rearing plants. The other department, which relates to the production and treatment of stock, has likewise advanced, though here the improvements are perhaps less striking. The physiology of breeding, in particular, is a subject beset with difficulties, and has not sufficiently attracted the attention of those who should be most interested in it. In our remarks we have touched only on a few of the salient points, because these are most ready to catch the eye; but we should form an erroneous estimate if from these alone we were to judge of the present condition of agriculture. The whole practice is improved. Its most ordinary operations are carried on in a superior manner. Where defects are observed, they are sought to be removed by referring the varying conditions of each case to the scientific principles on which it depends. More enlightened views and fuller knowledge of principles are observable in all its departments. And if the question be asked, What is the result of all this?—what can be shown in proof of the efficacy of these improvements?—what are the actual achievements which the art can now accomplish?—an answer may be given by the following extract, describing the proceedings at Boxted farm, near Colchester, at a recent meeting of the Agricultural Society of England:—

The principal object of attraction was Fowler's steam-plough, and the various operations connected with preparing the soil for a crop, with the depositing of manure and seed. It is certainly the first time in England that the land was cleared of one crop and another sown on the same day.

As the grain was cut by the reaping-machine, it was taken to the thrashing-machine stationed in the field, which was moved by steam. As the land was cleared, the steam-plough speedily turned over the soil, the harrows followed to pulverise, and the machine depositing superphosphate with turnip, and also rapeseed at the same time, followed, the land in the evening presenting a beautiful surface, smooth and neatly finished. Nor was this all. The wheat as it left the thrashing-machine was taken to the flour-mill, and in a short space of time bread was presented to those present of excellent quality, and was much praised by those who enjoyed the novel circumstance of wheat cut and bread produced from it on the same day, in a period of about eight hours.

The steam-plough turned over the soil at various depths, from 6, 8, 10, to 12 inches, at the will of the person in charge. It moved at the rate of $2\frac{3}{4}$ miles per hour, deducting the time of stoppages for shifting the anchors, &c. The quantity ploughed was at the rate of eight acres in ten hours. The force required equalled 21 horse power, or $21 \times 33{,}000$ lb. lifted one foot high per minute. Consequently the steam-plough did eight acres in ten hours, being as much work as eight men, with eight ploughs and sixteen horses, could have done in nine hours.*

Great as the progress of agriculture has lately been, still more important improvements may, we think, be anticipated for it for some time to come. With the return of peace, and the accumulation of capital, for which it will be difficult to find profitable investments, it is reasonable to think that many will have recourse to an occupation which makes the nearest approach to some of the advantages of landed property—admitting of rural employments and field-sports being conjoined with an interesting and profitable industrial pursuit. Additional motive will arise for the extension of our culture, in Scotland at least, from the fact disclosed by the statistical returns, that our produce is so much short of what was supposed, and of what the country is capable of yielding. Every operation is likely, therefore, to receive increased attention, and everything will be pressed into the service that skill and capital can command. The sciences, in particular, capable of aiding husbandry, will be more diligently cultivated and more carefully applied, for they must be always looked to as the source from which its greatest advantages are likely to be derived.

Agriculture is sometimes spoken of as being itself a science, but more frequently it is regarded as an art. Johnston, Stephens, and many other modern writers, speak of it as an art; Professor Wilson and a few others designate it a science. Indeed, the terms seem to be often employed interchangeably, or as if the person using them had no precise idea to which of the categories it really belonged. Bacon defines art as a system of rules serving to facilitate the performance of certain actions, in which sense it is opposed to science, or a system of speculative principles; but

* *North British Agriculturist*, Aug. 20, 1856.

he is accused by Dugald Stewart of not adhering to his own definition, and confounding together the sciences and the arts under the same general title. According to the usual acceptation of the term, agriculture must undoubtedly be regarded as an art, although, like the other arts, it enlists science in its service, and, in fact, has a most intimate relation with almost every branch of physical science.

Although, as has been well observed by Dugald Stewart, in an enlightened age, the sciences are justly considered as the basis of the arts, and, in the course of a liberal education, the former are always taught prior to the latter, yet in the order of invention and discovery, the arts preceded the sciences. Men measured land before they studied speculative geometry, and governments were established before politics were studied as a science. But their connection is close, and no exertion should be wanting to render it more and more intimate. They should grow with each other's growth, and strengthen with each other's strength; and for this purpose they ought to be brought into continual contact, and frequent comparisons made of their respective conditions. It is the province of science to foster art; and to do this effectively it is necessary that the condition of the latter should be fully known, and special prominence given to all its wants. It is no doubt the duty, as well as the practice, of scientific men, in the course of their researches, to keep these wants in view; and its application to practical uses—in being made to minister to the wants and remove the discomforts of our race—will always be regarded as the greatest triumph, the crowning glory, of a scientific discovery. But such a result will be rendered much more frequent and certain, if their researches be frequently drawn into particular channels, and fixed upon certain points, by practical men, who have there encountered a difficulty, and wish to have it removed. By being thus presented, as it were, with problems for solution, they will feel that a more direct appeal is made to their attention, and they are more likely to call forth all their resources, and concentrate all their powers, to meet the exigencies of the case. We might never have heard of that precious invention, the safety-lamp, if repeated and disastrous accidents had not led to an urgent application to the chief chemist of his day, whose efforts were thus directed to a single object, and his philanthropy made to act as a spur to his genius.

It has been the misfortune of agriculture that, up to a recent period, practical men have had little intercourse with men of science. They followed husbandry successfully as a practical art, and have but of late years become sensible of the advantages to be derived from the resources of science. "Could the man of practice, however," Mr Stephens observes, "supply the man of science with a series of accurate observations on the leading ope-

rations of the farm, the principles of these might be truly evolved; but I conceive the greatest obstacle to the advancement of scientific agriculture is to be sought for in the unacquaintance of men of science with practical agriculture. Would the man of science become acquainted with practice, much greater advancement in scientific agriculture might be expected than if the practical man were to become a man of science; because men of science are best capable of conducting scientific research, and, being so qualified, could best understand the relation which their investigations bear to practice; and, until the relation betwixt principles and practice is well understood, scientific investigation, though important in itself, and interesting in its results, would tend to no practical utility in agriculture. In short, until the facts of husbandry are acquired by men of science, these will in vain endeavour to construct a satisfactory theory of agriculture on the principles of the inductive philosophy."* The evil here referred to is, we trust, in the course of being remedied; scientific men are becoming better acquainted with the operations of agriculture, which are not difficult to learn, while both they and men of practical experience are becoming more alive to the expediency of mutual co-operation, to enable them to satisfy the expectations of the public, whose interests are deeply involved in the case.

Perhaps it was because too much was expected of chemistry, that some disappointment has been felt as to what it has actually done for husbandry. No doubt, considerable errors have been committed by defective modes of analysis; and even now we find such men as Professor Way retracing his steps, and renouncing his former conclusions.† "When chemistry began to be applied to agriculture," says Dr Anderson, "it was from the determination of the composition of the soil that its principal advantages were anticipated. The expectations naturally formed have been but very partially fulfilled; for, as our knowledge has advanced, it has become apparent that it is only in rare instances that it is possible, satisfactorily, to connect together the composition and the properties of a soil, and with each advancement in the accuracy and minuteness of our analysis the difficulties have been rather increased than diminished. It has become more and more obvious that the question of the composition of a soil is one of extreme complexity, and we are now convinced that it will be necessary to commence again almost *de novo*, and, discarding many of the observations hitherto made, endeavour to determine the fundamental principles on which the fertility of a soil depends." But the errors and defects belonging to our own mode of proceeding are unjustly chargeable on chemistry, and instead of producing dis-

* *Book of the Farm*, vol. i. 19.
† See No. XXXVII. of the *Journal of the Royal Agricultural Society of England*.

couragement, should excite us to a more intelligent use of it. It was a very general practice to collect, for the purpose of analysis, specimens of soil from different parts of a field, and from a mixture of these its average quality was sought to be obtained. By this process, what result is arrived at? We analyse a soil different from any existing in the field; a factitious compound of our own, such as possibly may not be found in nature. It is obvious that any inference derived from, or any process of improvement based on, such an analysis, can lead to nothing but disappointment. But in that and similar cases the science of chemistry is not to blame. We must learn from such failures to use greater precautions; and when chemists have had further experience in a comparatively new field of research, they will satisfy all reasonable expectations, and justify us in regarding their science as holding the key to many of the operations on which the prosperity of agriculture depends.

In the application of science to agriculture we must frequently be contented to wait for results which deserve the character of being of great practical importance. An effort has been recently made to make Meteorology contribute more directly to the cause. The very attempt is a step in advance, and implies the existence of enlightened views as to the true interests of the art. In a department so extensive as this, and embracing phenomena of so complex and subtile a nature, observations may require to be continued for a considerable period before important practical deductions can be made. But it would be short-sighted policy indeed to allege this as a reason for discontinuing or conducting them with indifference. Their scientific interest and value are unquestionable; and who can say when the facts of science may enter the paths of common life and influence our everyday habits? Many years have elapsed since Sir Humphry Davy discovered aluminium; and for all practical purposes the discovery has since been barren of consequences. Now there is the prospect of being able to obtain it from a common earth—an earth, next to silica, the most abundant constituent of the earth's crust,—and to manufacture it everywhere for common use. It is to such cases that Laplace's observation emphatically applies—"That a discovery the most barren in appearance may one day have consequences the most important." It has been as justly as beautifully remarked, that truths, like the stars, are clustered together in constellations; hence the discovery of one fact, though in itself apparently unimportant, may lead to another of greater moment with which it is naturally connected. It is thus that discovery becomes the parent of discovery, at once affording a motive for perseverance and the means of success.

It appears to us, therefore, of consequence that agriculturists should always keep in view the intimate connection that exists

between the sciences and the art which it is their object to promote. It is of advantage to keep the leading facts before them, and advert occasionally, in the midst of their practice, to first principles. With these views, it is our intention to draw the attention of our readers for a little to some of those branches of Natural History which have a relation to husbandry; and for this purpose we shall first consider

Geology in its relations to Agriculture.—In order to perceive the intimate connection that subsists between geology and agriculture, we have only to consider that it is from the rocks composing the crust of the earth—the consideration of which constitutes the province of geology—that the materials are derived for growing the plants which it is the object of agriculture to cultivate. In point of time, the mineral kingdom existed prior to the other kingdoms of nature, and the latter may be said to derive from it their origin and means of subsistence. Without a mineral we could not have had a vegetable, and without a vegetable we could not have an animal kingdom. The plant, viewed in this light, may be regarded as the lowest grade of organic life, in which the elementary matter supplied to it by minerals and the atmosphere are wrought up into new forms, and made subject to new combinations. "The rigid lines and angles of the crystal are now moulded, as it were, into delicate tubes, and woven into complex tissues; and the motionless permanence of the inanimate body gives place to a wonderful series of rapidly varying phases and evolutions of the living being. The plant, thus gifted with new and higher powers, is enabled to act on matter with special energies, and thus to supply animals and man with many substances useful for food or clothing, which they could not themselves extract from the inorganic world." * The crust of the earth, therefore, with the history of which geology is conversant, is not only the platform on which the whole of animated nature lives and moves, but from the crude materials of which its surface was composed, when it emerged from the primeval waters, have been elaborated the substances by which all life is nourished and sustained.

It will render the subject we propose to illustrate more easily understood, if we advert, in the first instance, to the manner in which soil must have been at first formed. It is obvious that, in early geological times, when the waters under which the sedimentary rocks have been formed receded from them—or, what is virtually the same thing, when they were heaved above the waters by some force acting from below—they must have presented an entirely naked surface. That surface must either have consisted of bare rock, as in the case of the igneous rocks, or loose debris, gra-

* Professor Nicol's *Inaugural Lecture*, p. 19.

vel or sand, accumulated on the more horizontal strata of the aqueous deposits. For a length of time — of longer or shorter duration, for geological time must always be regarded as indefinite—no vegetation could exist, for there could be no suitable receptacle for it. By and by the action of the atmosphere, aided by the sun, showers, and frosts, would produce a disintegrating effect even on the hardest surfaces, and the superficies would be rendered loose and friable. The loose and crumbling matter thus produced would be carried downwards from the higher elevations by currents of water, when, coming in contact with stones and gravel carried by the stream, it would be still further broken down and triturated, till it was at length deposited in hollows and levels, in the form of earth, clay, or mud. This deposit would consist of the ingredients of the different rocks from which it was derived, of siliceous matter, clay, or lime, or a mixture of all these in various proportions. Here, then, we have what may be called a soil, but it is exclusively of a mineral nature, no admixture of vegetable, much less of animal substance, being yet possible.

If it were the fact, as modern works often expressly tell us, and permit us still more frequently to infer, that the two ingredients of ordinary soil—that is, both mineral and vegetable matter—are essential to the growth of plants, we should here encounter a difficulty of which it would not be easy to give a solution. If the earliest plants required mould—that is, vegetable earth—to enable them to grow, whence could it be derived, since it is only by vegetable growth and decay that mould can be formed? To account for the existence of vegetable life, therefore, we are constrained to admit that plants might derive all that is necessary for their growth from the disintegrated substance of rocks, and from the atmosphere. "Every existing species of plant," says Dr Daubeny, in his opening address at the recent meeting of the British Association, "must have obtained its nourishment (under the circumstances of which we speak, the dawn of vegetable life) solely from the gaseous constituents of the atmosphere, and from the mineral contents of the rock on which it vegetated." That there should be no hesitation in making this admission, at least to the extent that a certain kind of vegetation could be so produced (which is all that is necessary to remove the difficulty in question), may, we think, be shown from appearances continually witnessed around us. That certain plants grow readily in water, without ever coming in contact with any soil, whether mineral or vegetable, is a fact sufficiently familiar to all. Some plants, such as the *Lemnaceæ*, or duckweeds, are organised for floating in water, as their natural abode, and derive from it and the air their whole nourishment. Seaweeds, for the most part, derive all their nourishment from the element in which they float. Others, again, are capable of living

in the air, and *on* it; from which circumstance some of them are expressly named air-plants; and there are many other curious instances of the same thing. One plant (*Urostigma australe*) is mentioned by Dr Balfour, which has grown for nearly twenty-five years in the Botanic Garden of Edinburgh, suspended in the air. "*Urostigma elasticum*, *Ardisia crenulata*, *Agave* (Littaea) *gemmipara*, *Billbergia nudicaulis*, and *Phœnix farinifera*, have continued to grow for nearly four years, suspended in the air, and merely moistened by common water allowed to come into contact with the roots by the capillary action of a worsted thread. The plants have produced leaves, and some of them flowers. They derive their organic nourishment from the air, and the quantity of inorganic matter in the water appears to be sufficient to supply their wants in that respect for a long period."* The *Tillandsias* and *Orchids* are not parasitical plants, but epiphytes; that is to say, they do not derive their nourishment from the plants to which they adhere, but use them merely as supports; and all that is necessary to nourish their strange forms and develop their large and grotesque-looking blossoms, must come from the atmosphere. Examples of this kind it is unnecessary to multiply.

There are entire families of plants, of low organisation, part of whose office in the economy of nature seems expressly to be, to transmute the substance of rocks into vegetable matter, and prepare a suitable pabulum for the higher members of their class. These are lichens, confervæ, and a few others. Over the hardest surface of a piece of granite or greenstone—or, what is of still closer texture, clinkstone or basalt—one of the former will spread itself, in the form of a thin hard crust, on the side most exposed to the weather. This position it prefers, because it is from the pelting rain and wind, and the other atmospheric phenomena which collectively we call weather, that it is chiefly to obtain its nourishment. Roots, properly so called, it has none, either for fixture or food, for it can take in nutriment at every pore, and it clings to its rocky bed as adhesively as a plaster, or rather it looks like a warty efflorescence from the stone itself, of which it still continues to form a part. Many of the confervæ are minute plants, thread-like in form, and of simple structure. They appear, as well as in other places, on the surface of stones which are much exposed to damp, and cover them with a coating of green hair-like filaments, which sometimes looks not unlike the pile of plush or velvet. A stone from such a place as Craigleith quarry, and consisting, therefore, almost entirely of particles of quartz, or nearly pure silica, and with a hewn, or even polished surface, will gradually be overspread with a crop of this substance, if kept in a moist situation. In all such cases—for there are many others of a similar kind—can

* Art. "Botany," *Encyc. Brit.*, 8th edit. v. 97.

it be doubted that the atmosphere is the source of all the nourishment the plants receive, except what may be derived from the mineral body to which they adhere? If this conclusion be inevitable, we have here distinct examples of vegetation going forward without vegetable soil, and can account for the process by which the latter was at first generated and came at length to supply the wants of a higher class of plants; for lichens, confervæ, and such plants of humble growth, would in time decay, and their remains would impart the vegetable element to the soil, now rightly deserving that name, as including all the ingredients belonging to it in its complete or normal state. In this another and superior class of plants would spring and flourish, in circumstances more resembling those in which they are at present placed. The decay of these in their turn would further contribute to enrich the soil, till at length it possessed all that was requisite to meet the wants of every kind of vegetable life.*

From these considerations it will appear, that to suppose, with Dr Daubeny, that at the first commencement of vegetation *every* existing species of plant must have obtained its nourishment solely from the rocks and atmosphere, is to encumber the subject with unnecessary difficulty. It is enough for the purpose to suppose that vegetable tribes, of low organisation, lived then as we see them capable of doing now, executing functions similar to those they do at present, readily assimilating mineral matter, and, with the assistance of the atmospheric gases, converting it into vegetable, and thus paving the way for new and higher vegetable forms entering upon the scene. In the appearance of these, there can be no difficulty in admitting a succession of tribes or generations, according as the soil became better fitted to receive them. Thousands—tens of thousands—of years must have elapsed between the appearance of the species of plants characteristic of the old

* It is asserted by Dr Gregory, that it has been proved by direct experiment that plants will thrive in a purely mineral soil, provided it contain all the mineral elements essential to the growth of the plant. "In that case," he adds, "the plant obtains from the air exclusively, through water, the carbonic acid and ammonia from which it obtains the whole of its carbon and nitrogen." Wiegman and Polstorf, we are informed by Prof. Johnston, collected a quantity of pure white quartz sand, digested it in a mixture of nitric and muriatic acids, and then washed it well with distilled water. In this sand, which contained 98 per cent of silica, they sowed seeds of various kinds—oats, barley, tobacco, trefoil, &c.; and as they grew, watered them with distilled water. The plants, when burned, gave an ash which invariably contained more potash, soda, lime, and silica, than was present in the original seeds. The young plants, therefore, by means of their roots, had extracted from the insoluble part of the sand—which the acid refused to touch—the several substances which were necessary for their growth. They did not grow luxuriantly, nor become robust or perfect plants. This was not to be anticipated. But this extreme experiment shows that the roots of plants may gather food where we could hardly expect them to live, and that the inorganic substances they obtain in the soil, if *sufficiently abundant*, need not necessarily be in a very soluble state.—*Lectures on Agricultural Chemistry*, p. 437.

red sandstone or the coal-measures, and such as are found in the newer formations, and we need not hesitate to admit something of the same nature in regard to those of the existing system.

Having thus adverted to the manner in which soil was at first formed, and endeavoured to explain the manner in which it acquired its vegetable ingredients, we proceed to the further consideration of its connection with the subjacent rock-formations, and the manner in which, as far as it is dependent on these, it has acquired the diversified forms and qualities it now presents.

To enable those of our readers to whom geology may be new, to follow us with advantage in our subsequent remarks, we think it desirable to say a few words on the mode of formation and composition of rocks. This, however, we can here attempt only in a very general way; for matters of detail, reference must be made to works expressly devoted to geology, of which there are several elementary ones of great merit.

The *crust* of the earth, so often mentioned in geological writings, is the rocky structure which forms its surface, and is continued downwards as far as the comparatively short distance we have been enabled to penetrate. It is composed of two distinct series of rocks, different in their origin, structure, and external aspect; and it is from the different modifications these have undergone, the fractures, abrasions, and inundations to which they have been subjected, that all the mineral materials are derived which are strewed, in such a variety of ways, over the earth's surface, and with which, in some form or other, the agriculturist has to deal.

The waters of the ocean, at one time universal, were at a subsequent period contracted, or, in the language of Scripture, "gathered into one place," by the appearance of a portion of land above the surface. Still the ocean was more generally diffused than at present, and covered most of those places which are now dry land. The waters, kept in violent and incessant agitation by the volcanic outbursts and general commotion to which the crust of the globe was then subject, contained an immense quantity of mineral matter, derived from the breaking-up and comminution of previously existing materials. This mineral matter was held suspended in the water, in the form of small particles, sand, or mud; and when the waters became comparatively tranquil, it gradually fell to the bottom, and was deposited there in layers, just as the silt or mud, carried into them by floods, may be seen to do in the lakes and river-pools of the present day. When the waters, charged with certain substances, had thus deposited their contents, they would, in the course of the changes which then proceeded on so vast a scale, become filled with matter of a different kind, which might be deposited on the top of the former, at that time forming the bottom. In this way came to be formed

all that class of rocks which compose strata, or which form flat masses traversed lengthwise by parallel seams, these seams marking, for the most part, some change in character of the matter deposited. The rocks of this class being formed from water, are sometimes named *aqueous*; or, as they are composed of sediment, *sedimentary*; or, finally, *stratified*, from the seamed structure just referred to. It is obvious that if there existed the remains of plants, fishes, or other animals in the waters at the time the mineral matter was deposited, these would be deposited at the same time, and remain imbedded in the rock, secure from further change, after it became consolidated. And this is the way in which the most interesting organic remains have been preserved to us.

The rocks forming the other great class consist of mineral matter, which is supposed to have been once in a fluid state from the action of excessive heat. In this condition it has been thrust upwards from below by volcanic agency, through openings previously existing, or which it made for itself by forcing a passage, and has partly overrun the surface like molten lava, and partly been heaped up into conical masses or crested ridge-like elevations. In the process of cooling, the fused materials were segregated from each other and became crystallised; but these crystals, which appear more or less perfect, and of all possible dimensions, are so intimately bound together by cohesion and mutual penetration, that although, in some cases, there is no basis or cementing medium, these are among the hardest and most compact rocks with which we are acquainted. These rocks, in reference to their origin, are called *igneous* or *volcanic*, or, in reference to their structure, *crystallised* rocks. In the process of cooling, a certain class of them show a tendency to form columnar masses, which, when inclining to a horizontal position, resemble the steps of a stair, whence they are named *trap* rocks.

If the former class, the sedimentary rocks, had been the sole constituents of the earth's crust, it would have formed an almost uniform flat surface, varied only by the eroding action of running water, which, too, would have then been very inconsiderable compared with what it is now. It is the action of the igneous rocks that has produced that varied configuration of contour—that endless alternation of mountain and valley, craggy steep and undulating upland, which renders it, as a landscape, so agreeable to the eye, and which so admirably fits it for the abode of man, as well as that of the plants and animals which minister to his wants. Not only are these eruptive masses themselves raised on high, forming the principal mountain summits in every country of the globe, but they have carried with them, so far, in their upward progress, the previously horizontal beds, which now lie at angles more or less inclined on their sides, graduating the abrupt-

ness of their descent, and softening their rugged outlines, as it were with a kind of undulating drapery drawn round their base. Thus disrupting the strata, displacing them in every possible way, heaving them upwards and leaving them at all angles, setting them on edge, contorting them, and even producing a kind of metamorphosis in them at the points where they came in contact with their heated or incandescent mass—it is by the igneous rocks that a large class of these phenomena have been produced which engage the attention of geologists.

The earlier geological phenomena are all on a scale of vast magnitude, and operations of the same nature seem to have been going on simultaneously nearly in all parts of the earth. Climatic zones, and the diversities now caused in different regions by temperature and other influences, can scarcely be said to have then existed; and when the old red sandstone, for example, was deposited in our own islands, it was so also, under nearly the same conditions, in continental Europe, in Asia, and America, everywhere presenting nearly the same appearances, and characterised by the same fossils. There is not great difficulty, therefore, in general, in recognising rock-formations in different parts of the world, and referring them to their proper place in the series. But although deposited nearly at the same time, and under similar circumstances, wherever they are found, they do not always occur lying above one another in invariable order according to their age. This, however, is owing to certain members of the series being wanting; for the order of superposition, according to age, is invariable in all that occur in any given locality. And if they could be presented to us in the entire series, we should find them arranged in a certain succession, from which they never deviate. But an apparent irregularity is continually observed, owing to the absence, in a given spot, of certain deposits, and hence it is that the surface of the ground—the place where all our agricultural as well as other operations are conducted—may consist of any one rock-formation out of the whole series;—not that that one is out of its place, but that the others happen to be absent. Thus, in the neighbourhood of Edinburgh and Glasgow, the rock-formations forming the surface belong to the coal-formation; in the neighbourhood of Selkirk and Peebles, the greywacke or lower silurian; of Jedburgh and Perth, the old red sandstone; of Aberdeen, granite; of the greater part of Inverness-shire, Sutherland, and Ross, gneiss; of Helmsdale, and portions of the Isle of Skye, the lias and oolitic formations, which are comparatively of recent date.

The variety produced by this arrangement, and the facilities it affords for us to avail ourselves of the various useful substances contained in the different strata, is a circumstance too remarkable not to deserve notice. If we could reach the coal-seams of the

carboniferous system, or the metallic veins of the primary schists, only by penetrating the whole mass of superincumbent formations, the task would be a hopeless one;* but they are successively brought to the surface, offer themselves, as it were, to our examination, and enable us to obtain, with the least amount of labour, whatever they contain conducive to our comfort. Still farther to this purpose contribute the tilting-up and inclined angles so generally observed in the disposition of the beds; and thus the very throes and convulsions of the early world, which we might suppose calculated to produce nothing but confusion and disorder, have been made to minister directly to our welfare, and that in a manner so effectual, that it is difficult to see how it could have been done so well in any other way.

To the elevation of the stratified rocks, and the convulsions they have undergone by the eruptions of the igneous ones, are owing the whole series of dykes, rents, fractures, and other dislocations, which have frequently considerable influence in determining the mineral character of the surface.

When we consider the varied aspect of the earth's surface, and the great diversity in external appearance of the rocks which compose it, we are naturally led to think that a vast multitude of simple minerals must combine in their formation. This, however, is so far from being the case, that the very reverse is nearer the fact; and we find that only a very small number indeed perform a principal and essential part, and that it is by assuming such a variety of forms, and entering into so many combinations, that they bulk so largely to the eye. In this department of her works, as well as in so many others, nature may be said to work with few materials; but in her hands they are so plastic that the result seems as varied as if they had been drawn from an unlimited number of sources. The greater number of simple minerals are rare, and occur only in small quantities, and instead of forcing themselves on our notice, must be carefully sought for in the veins, cavities, and recesses where they lie concealed.† When we enumerate the following substances—namely, quartz, felspar, mica, hornblende, actynolite, augite, hypersthene, gypsum, chlorite, talc, steatite, carbonate of lime, and clay, it may appear surprising that we have named the principal ingredients of which nearly the whole series of rocks is composed. When we have learnt, therefore, to recognise these minerals—which may be called, by way of eminence, geological minerals—in their different forms, com-

* A rough calculation of the thickness of the sedimentary rocks, regarded as lying one above another, makes it amount to upwards of three miles, a depth greatly exceeding that to which we have hitherto penetrated into the earth's crust.

† The entire amount of the minerals described does not much exceed 400. Of these, only 60 are of common occurrence; and the few mentioned above are the only ones that enter largely into the composition of mountain rocks.

binations, and properties, we have made an important step in practical geology, and may be said to have mastered the chief difficulty in discriminating mountain rocks. The first mentioned of these minerals, quartz, occurs in greatest abundance, and it is remarkable in what a variety of forms it presents itself to our notice. In a massive state, generally pure white or tinged with grey, it forms entire districts, as in the islands Jura and Isla. A broad belt of it runs in a north-east direction across a great part of the country, from Glenorchy in Perthshire, to the neighbourhood of Castletown of Braemar in Aberdeenshire. Considerable areas of it occur in Sutherlandshire, and in one of these rises the conical stack Ballock-nan-fey, whose naked ridge shines in the sun like snow, and was described by Pennant as marble. It forms one of the principal ingredients in granite, gneiss, and mica slate, and enters largely into the composition of many of the other rocks. The principal sandstones are composed of particles of quartz bound together by some cementing substance. The sand of the sea-shore is, for the most part, similar particles in a loose state. In veins and cavities we find it crystallised in the purest form, when it becomes rock-crystal; tinted more less deeply, it is cairngorm or amethyst, chalcedony, carnelian, heliotrope, rose-quartz, &c. In districts where the old red sandstone conglomerate occurs, quartz pebbles are very plentiful, and they are strewn over the face of the country, where they are known as cow-lady's-stone. This, then, is the most abundant of all minerals, and performs the principal part in what may be called the osteology of the globe—the constitution of its rocky crust. Of that crust it has been calculated that it composes one-half; and, consisting as it does of nearly pure silica,* it not only influences materially the character of soils, but enters, as is well known, into the substance of plants, especially the culms of the cereal grasses.

* 97.50 silica; 0.25 alumina; 0.50 peroxide of manganese.—ROSE.
95.00 " ; 1.75 " ; 0.25 " " 1.50 lime.—KLAPROTH.

(*To be continued.*)

AGRICULTURAL NOTES IN OHIO AND MICHIGAN.

By R. Russell, Kilwhiss.

Left Cincinnati, Ohio, on the afternoon of 24th October 1854, for Springfield, eighty miles to the north-west, where the National Agricultural Society held its annual exhibition. The country in the neighbourhood is moderately fertile. The soil consists for the most part of a sandy loam, dyed into a dark hazel tinge, which is peculiar to all those soils upon which oak and hickory are the predominating trees in the forests. The subsoil is usually gravelly, but often mixed with clay. Indian corn and wheat are the principal crops which are cultivated; a few sheds for drying tobacco were seen as we passed along. The soil is genial to the growth of clovers, and it produces good pastures when seeded with those grasses that are natural to the land.

Springfield contains a population of 7000 inhabitants, and is in a very flourishing condition. Agriculturists were attending this meeting from all parts of the Union. The secretary had travelled from Boston, a distance of nine hundred miles, by railway; and some of the other officials almost as far from the south and from the west. Some of the judges had come from Canada. The greatest number, however, were from the neighbouring states of Kentucky, Indiana, Illinois, and Michigan.

There was nothing shown but cattle, and the great majority were short-horns, for which the soil and climate of southern Ohio and Kentucky seem admirably adapted. I was quite astonished at the general excellence of the stock. Among the hundred and fifty short-horns that were exhibited, there were few animals that could be considered second-rate. I am not sure if the short-horned stock was so uniformly good at Windsor in 1851, though there might be some better animals. One bull had been lately imported from England, and had cost the owners six thousand dollars. The animals were kept beautifully clean, for great care was bestowed in having them properly groomed. Shortly before a fine ox was led into the ring, I saw three negroes rubbing him down most vigorously with their hands, to put the last polish upon his sleek skin. From the appearance of the animals on the show-grounds, as well as of the large herds that I saw in the meadows in southern Ohio, I am led to believe that the soil and climate are well fitted for maintaining the shape and qualities for which this breed is distinguished. Here there is no evidence that it is deteriorating; but the extent of land capable of yielding fine pasture is comparatively restricted in Canada and the United States.

During the few days that I remained at Springfield, I had many opportunities of conversing with the farmers from Kentucky, and obtaining a knowledge of their systems of husbandry. Ken-

tucky is a slave state, and the size of the farms on the best lands is larger than they are in Ohio. The common size of the farms in the best grazing districts is from 300 to 400 acres, but many are as large as 1000. There is not much variation in the mode of cropping. One gentleman whom I met possessed 360 acres, of which 100 were under thinly timbered woods that yield excellent pasture. The 260 acres of arable land were allowed to remain for six years under grass, and then, after being cropped for another six years with wheat or Indian corn, sown out again for pasturing. Six hands were required to manage this extent and attend to the stock, and eight horses were required for cultivating it.

I was informed that a field, after it had been cropped with Indian corn for eight years, would fill up in four years with the fine blue grass which is so valuable for pasture in Kentucky, although no seeds were sown. So natural is this grass to the soil, that at the end of this period it would extirpate all the weeds that infest the cultivated fields. But by sowing grass-seeds with the last grain-crop, fine pasture would be got the succeeding year. The Kentucky limestone soils, that are so genial to the growth of the finer grasses, are, comparatively speaking, like the same class of soils in Ireland, inexhaustible.

Rearing mules for the southern markets is carried on to a great extent in Kentucky and Tennessee. The gentleman who occupied the farm above described usually grazed forty of these animals during the warmer months. In winter it costs 16s. 8d. (four dollars) a-month for keeping a mule, as it is allowed as much Indian corn or oats as it can consume. An ox on grass is kept for one dollar a-month. Though the Ohio is often frozen over in winter, the cattle are not stabled; the wood-pastures, however, afford good shelter from the high winds. They are fed upon hay and Indian corn: the latter is given to them as it is cut from the fields. One would be very apt to suppose that great loss would arise from the imperfect manner in which cattle would masticate the unground grain of Indian corn; but a lot of pigs are usually wintered with the cattle, and act in the character of a save-all. Some of the pasture-fields, too, are often allowed to grow after the middle of July, and they thus afford good winter grazing.

That the natural produce of wheat is much smaller in the fine grazing lands in Kentucky than in the country immediately to the south and north of Lakes Erie and Ontario, was the testimony of all the farmers that I conversed with. The same lands which yielded on an average 75 bushels of Indian corn, would not yield more than 18 bushels of wheat. In southern Ohio and Kentucky Indian corn obtains those conditions of climate which are favourable to its producing its maximum yield, but which are not equally well suited for bringing to maturity large crops of wheat.

Clover and timothy succeed very well in Kentucky: the latter is in great repute for hay. But when the land is allowed to remain in pasture, the blue-stem grass occupies the ground and puts all the others out. Large quantities of hay are made in the western parts of the State, pressed into bales, and sent down the Mississippi to New Orleans; for this is a scarce and high-priced article in all the States south of Tennessee.

I could soon readily distinguish the Kentuckians from the northern farmers. Some of the former that I saw here were noble specimens of humanity. Exemption from severe manual labour for several generations, it would seem, has not been without its influence on the Anglo-Saxon constitution. All that the Kentuckian usually wants is the fine fresh and ruddy complexion to make him every inch an English country gentleman. Had Buffon seen the produce of Kentucky at the exhibition at Springfield, he would have qualified his theory of the degenerating influences of the climate of North America upon men and animals. But the northern farmers, on the other hand, are much smaller men, with a vast amount of activity and energy. All who labour with their hands upon the land in America lose that full habit of body which even our agricultural labourers have at home. A difference in the dietary may have something to do with the matter, but the great extremes of the climate, conjoined with field-work, are the principal elements. It struck me that both the men and women among the wealthy commercial classes in the Northern States were more robust than among the agricultural.

The ground is seldom manured for crops of any kind in Kentucky or Ohio. As yet labour appears to be worth more to be applied in cultivating a larger area of land than in collecting and applying manure to a smaller one. However, as the most of the stock is fed out of doors, there is little manure made about the yards. The principal maize-producing districts in Ohio are along the margins of the Scioto and Miami rivers, which are too rich for wheat. General Bierce, in his address to the agriculturists assembled at the county fair at Medina, said that "sandy land is preferable for wheat over clay soils." This sounds rather curiously to a Scotch farmer. The General gave a chemical reason for it, which I need not repeat; but the circumstance shows how much climate may alter our ideas respecting the characters of the soils which are best suited for certain crops.

A large marquee was erected within the grounds to accommodate one thousand persons at the banquet which terminated the proceedings. About this number of ladies and gentlemen sat down to a cold luncheon. Before the guests entered, they marched in procession around the grounds, headed by a band of music. Both ends of the erection were only closed to the height of four feet from the ground. The sides also had an open space all round, so that any

one on the outside could easily see and hear what was going on within, if he chose to approach; and very soon the external company became much larger than the internal. After dinner all were put upon a footing of equality. Some of the speakers addressed themselves quite as much to those who were outside as to the guests proper. It was not to be expected that the topics discussed at such a meeting would be confined to agriculture. After a short speech from the president on the success of the national show of stock—which seemed to absolve those who followed from all allusion to the question—each speaker launched out on his own particular hobby. There was one flowery and really eloquent speech from a Kentuckian, in which he took occasion to deprecate the "fanatical agitation" of the Northern States against the "peculiar institution." Some followed on the other side, and spoke with as much vehemence. A governor of one of the neighbouring States, mounting on the form, and turning round, chiefly addressed himself to those without, on the necessity of keeping the able men at home to manage local affairs, and to send all the "blockheads" to Washington. This was a very ridiculous and inflated speech, and I was rather surprised to find its author, whom I afterwards met, a shrewd, sensible, and practical man. A speech on the importance of protection to native industry called forth one, on the Reciprocity Treaty, by a Canadian, which, for wit and humour, with all the ornaments of the stump-orator, put the other speakers entirely into the shade. The crowd that were without were remarkably well dressed. One, who was close at my back, made the remark to his companion that a certain speaker, whose volubility was extraordinary, "would be hard to get down." The entertainment broke up about sunset, all seeming highly pleased with themselves and each other, notwithstanding the ardour of some of the speakers.

The weather was most delightful all the time that I was at Springfield. It was what is called the "Indian Summer." The mornings were cool, with fog in the low grounds, but during the day the sky was without a cloud. The heat was considerable in the afternoons, the thermometer rising to 66°. An almost complete stillness prevailed during the day, for there was scarcely as much air stirring as to rustle the rapidly fading leaves in the oak grove where the show was held.

A few of the spirited inhabitants of Springfield had guaranteed the premiums offered by the National Society. They expected to get out of this transaction by the money drawn for admission to the show-grounds; but the State fair had been held about a fortnight previous in a neighbouring town, when far greater attractions were held out to the general public than seeing well-bred cattle; for, besides the premiums that were offered for all kinds of agricultural implements and produce, some were also given to the ladies who could ride and manage horses most gracefully. This

novelty was the means of attracting immense crowds from all parts of the State. So no wonder the Springfield cattle exhibition was unpopular; and the receipts fell so far short of the expenditure, as to leave the managers to pay £1200 out of their own pockets.

I lodged in a boarding-house at Springfield that was under the direction of a gentleman and his two sisters. Some of the apartments were newly erected and in an unfinished state. It was overcrowded, and the guests soon saw that the staff of helps on this occasion was far short of the required number; so every one had to *help* himself in many things, and even to clean his own boots. I was rather pleased with the article which rendered this operation almost as gentlemanly a one as the brushing of a coat. A long-handled brush, with a smaller round one on its upper side for applying the blacking, enabled any one to put a capital polish on his boots with little trouble, and without taking them off. The landlord went about at his ease after serving us at the different meals, but his hands were otherwise pretty full, for he was likewise a banker and an editor of a newspaper.

Some of the orators who had not got their breath fully exhausted at the banquet, addressed the crowd from the windows of the hotel in the evening, on various political subjects. The curious thing to me was, that men who were really sensible in private conversation, should launch out in such a strain of exaggeration as was usual in their speeches; for the most of those with whom I talked upon the matter, look upon the whole as a piece of foolish acting. But it would seem, however, that this style is best calculated to gain the ear of the majority in the western parts of the United States. No wonder, then, that the more rational and enlightened use such efforts to educate the masses.

Left Springfield on the forenoon of the 27th for Sandusky, on Lake Erie, a distance of 134 miles. A level but slightly undulating country all the way, much of it cropped with wheat and Indian corn alternately; but near Sandusky, wheat and clover, as in Canada West, the common rotation. The forest still covered two-thirds of the country over which we passed. Oak and beech were the common trees, the leaves of which were still on, but the colours were fading fast. The immediate vicinity of Sandusky is flat and marshy; but a little to the south of this town, the limestone gravels and sands afford very productive wheat soils, more so than in any other part of the State.

The population of Sandusky is about 12,000, of whom one-half are of German extraction. The formation here is limestone, belonging to the upper silurian. It is covered in the neighbourhood of the lake with several feet of a peaty material, which on being removed exposes a surface beautifully smoothed and polished by the action of those agents that have transported to the southwards the

vast accumulations of sand and gravel which lie scattered over certain regions of Ohio. The floors of the cellars of the houses in Sandusky consist of this finely polished surface. A travelling-companion sought out a friend of his in town, by whom we were treated to quail, woodcock, black bass, and white fish for supper, which were all particularly excellent. These kinds of fish swarm in the lake, and are caught in great numbers. Took the steamer at night for Detroit, a distance of seventy miles, and at daylight found ourselves along the wharf of this great depot of western produce. On the opposite or Canadian side is the town of Windsor, which is the terminus of the Great Western Railway that traverses Upper Canada from Niagara by Hamilton. The Michigan Central Railway connects Detroit with Chicago. Hundreds of emigrants pass Detroit every day in summer for the west, and large numbers are constantly seen hanging about the station waiting for the departure of trains. In general they have a most emaciated appearance; and no wonder, after having suffered a long sea-voyage and great discomfort since landing. The piles of trunks and luggage of all sorts lying about on the wharf, gave me some idea of the vast human stream that was flowing to the westward. The railway company have a river frontage of half a mile, which was entirely covered with goods of one description or other. The river here is three-fourths of a mile in breadth, and flows at the rate of three miles an hour. It is of a fine green colour, as clear as crystal, and used for drinking without filtering.

Detroit has now upwards of 40,000 inhabitants. The houses are mostly built of brick, and the streets are wide and handsome. The number of fine villas in the suburbs, as well as the numerous handsome carriages rolling about in the evenings, indicate a population rapidly advancing in wealth and luxury. Three Presbyterian churches were in course of erection, one at a cost of 60,000 dollars, and another at 40,000. From the appearance of the streets on Sundays, this is a more church-going people than the inhabitants of Cincinnati. In the afternoon, however, I met several persons coming into town carrying large quantities of game.

Michigan is by no means so fertile as Ohio, though it contains a large extent of land capable of raising winter wheat. Its surface is very flat, little of it being more than 150 feet above the level of the lakes which surround it on three sides. It forms a part of that vast plateau which is drained by the Ohio and Mississippi, and which stretches through the southern parts of Canada West. Indeed, the soil in southern Michigan is very similar in character to the wheat soils of Canada West; I should say, however, rather lighter in general. The soil of northern Michigan is stiff and cold, and does not tempt emigrants to settle upon it. A large extent of land along the shores of Lake Huron is very swampy; and wherever dampness exists, there is more accumulation of vegetable

matter, which requires to be somewhat wasted by cropping before wheat can be raised upon it, even after the land is drained; for, until the virgin richness of the soil is in some measure rubbed off, autumn wheat generally suffers greatly from rust or mildew. I have no doubt that much of Michigan, as well as Ohio, will produce better crops of wheat after the fertility of the soil is somewhat reduced by cropping with Indian corn, oats, or barley.

In company with Mr Holmes, secretary of Michigan State Agricultural Society, I left Detroit by the railway on the 30th October for Ypsilanti, twenty-seven miles due west. The banks of the Detroit were originally settled by the French, and, as in Lower Canada, the farms consist of long narrow ribbon-like stripes which extend from the river. The French mode of settlement is not perpetuating itself in Michigan, for the descendants of the French are amalgamating with the Americans. The country to the westward of Detroit is flat, and much of it in need of draining, but it was well timbered, and clearings were going on very rapidly along the line of railway. At Ypsilanti the country is more rolling, and the soil is mostly sandy and gravelly.

The State Normal School is at Ypsilanti. There were 325 students from ten to thirty years of age—male and female in about equal numbers. The course of instruction is very complete; and every branch, from grammar to algebra, is taught by lectures. The algebra scholars were getting a thorough grounding;—not only had they to give the rule, but the reason for the rule, as they worked out the propositions on the black board. The students were the sons and daughters of the poorer class of farmers. They only paid six dollars each of fees for the winter session; and during summer they either taught in the country or worked at some trade. It is only from the families of the small farmers that teachers can be drawn, as the sons of others who are in better circumstances go into business. The students had fine open English faces; and Dr Welch, the Principal, remarked to me, it was wonderful how a little brushing up, through teaching, improved them in this respect; verifying Solomon's words that "a man's wisdom maketh his face to shine." The Americans, in general, make it a point to keep their faces clean, and to have their hair well dressed up. And when this is attended to, shabbier garments are often considerably relieved of their meanness.

There is no statutory obligation to have any religious exercises in this establishment, but a chapter of the Bible is read and a prayer offered up by the Principal before the lessons of the day begin. I was told by him that it would be considered by all as a very loose establishment if there were no religious exercises. A serious and church-going community can perhaps afford to have further religious instruction communicated by those who are specially set aside for this duty. The prevalence of the religious

feeling among the educated classes reacts on the educational establishments; and, from all that I learned during my tour in America, I believe that the effect of the present system of education is to leaven the ignorant masses that cross the Atlantic with a reverence for morality and things sacred. One has only to make himself acquainted with the state of some of those towns on Lake Ontario that were visited by Dr Dwight many years ago, and to compare his descriptions of the manners and morals that then prevailed with those existing at the present day, to be convinced that the tendency for the better is steadily progressing westwards, and gradually overtaking a ruder and rougher state of society.

Mr Uhl, a most intelligent farmer, who resides in the neighbourhood of Ypsilanti, drove us out in his waggon to his house, about three miles from town. His land was once thinly covered with oaks, and having the scrub or dwarf oak as an undergrowth. This kind of natural forest is called "oak opening." The soil reminded me very much of what I had seen in the district surrounding Paris, in Upper Canada. More Indian corn is cultivated here than I saw in any part of Upper Canada. The Dent variety of Southern Ohio ripens here, which would seem to indicate that the climate is rather warmer than in the same latitude to the eastward. The eight-rowed white variety, however, is cultivated more generally.

The soil consists of a light sandy loam, which seemed to contain but a small per-centage of vegetable matter; so much so, that I thought that it might do to mix with lime to make mortar. There was also little difference in the colour of the soil and of the subsoil. I was very much surprised when Mr Uhl assured me, that as good wheat and potatoes would be raised upon what was brought up twenty feet from the surface as on the surface-soil itself. If he ploughed deep, he considered that there was no occasion for applying any extraneous manure, save a little gypsum, for the clover or the Indian corn. The condition of this farm, when contrasted with those adjoining, served to confirm the opinion that I had already formed, that the wheat soils of America stand less in need of manure than of good cultivation, and a rotation of crops of not too exhausting a character. The young layers of red clover on this farm were very beautiful, and even the plants in those fields which had been pastured for two years were thick and vigorous. The rotation which he prefers is three years in clover, followed by Indian corn, and then wheat. Amongst the latter, clover is again sown. Wheat, however, is generally sown after clover in this part of Michigan. As in other parts of the Northern States, wheat is sown early in September; and the long autumns cause a very considerable growth before the frosts of winter set in with much severity. Some of the fields of wheat had a remarkably healthy appearance: the colour was of the darkest green, and the plants were thickly matted over the ground. For the first time, however,

I saw in one or two fields the depredations of the Hessian fly: its larvæ were rendering some of the edges of the fields of a rusty red colour.

Mr Uhl farmed at one time in the Genesee district, New York State, and follows the Genesee mode of farming to a certain extent. The clover fields, when they are to be seeded with wheat, are broken up from the 1st May to the 1st of July—a furrow from 8 to 9 inches in depth being given. The surface is then cultivated by the grubber until all the weeds are killed, and the wheat is sown broadcast from the 10th to 20th September. Indian corn is planted in squares, or check-rows, 3 feet apart, which system allows the land to be very completely worked by the plough, so that little hand-hoeing is required. Potatoes are also planted in squares, or check-rows—a practice common to all the Western States, by which the crops can be kept free from weeds with little expenditure of manual labour. The climate of North America causes the potato to grow many more long and slender stems than that of Britain; and when earthed up at the roots by the plough, very little hand-weeding is required. The presiding genius of American farming directs her votaries towards the economising of manual labour in every department of the art.

Mr Uhl is a great advocate for grazing more, and having less in cultivation; and no doubt the great rise which has taken place in the price of butcher-meat will have a tendency to alter the modes of farming that are pursued in many districts. The cattle were good specimens of the Durham breed. Sheep are not favourites, because they are considered to eat the clovers too close, and the land does not improve so rapidly as when it is grazed with cattle. There were 55 acres sown with wheat, and 20 in Indian corn. All the labour on the farm is performed with the assistance of two servants and five work-horses. Some of his neighbours were sowing a much larger proportion of their land with wheat. One farm, of 110 acres, not all arable, was pointed out where the land was very light, but on which 70 acres were sown with wheat, and on some of the fields several crops had been taken in succession.

Under good management, thirty bushels of wheat are sometimes got to the acre over the farm; but the average produce in Michigan is not one-half of this quantity. This year Indian corn had yielded Mr Uhl seventy bushels per acre. He sometimes sows it broadcast, and obtains about four tons of hay to the acre by cutting it in a green state. Gypsum is attended with very beneficial effects when applied to Indian corn, potatoes, or clover.

Next day we drove on to Ann Arbour, a distance of ten miles. The country was undulating, and the soil light, and much of it under wheat, which was very forward, but in some cases sickly, from the attacks of the Hessian fly. The Michigan University is at this town, where the more advanced branches of education are

taught free to all. A large library is forming, and a museum of natural history. An observatory was also just erected in the midst of a stump-covered country, on which stately trees had lately grown. In every township in Michigan a certain quantity of land is reserved for educational purposes, which affords the means of erecting and endowing free schools. There is no fear of over-educating a nation; for although education may be free to all, the capacity of a people to receive it depends upon the length of time which the parents are able to support their children at school. This is the real difficulty in educating a nation.

Left Ann Arbour in the afternoon, and reached Kalamazoo, a distance of one hundred miles. This is a small town, of four thousand inhabitants, that has very lately sprung up in the wilderness. The numbers of people travelling on business to different parts of the country were quite extraordinary. Next morning I found myself seated at the breakfast-table beside a backwoodsman, with his wife and family. They had all a somewhat melancholy cast of countenance, and seemed to be regardless of the stir that was going on around them. The husband, about fifty years of age, was wiry, but not robust. He told me that he had felled and cleared, in different parts of the country, upwards of 100 acres of heavily-timbered land, and had only got assistance at "log-rolling." As a pioneer in the desert, he spoke with great enthusiasm about his occupation, which, he said, "was hard, but very pretty work." In travelling over America one is very much surprised to find so large an extent of land cleared; but a few thousands of such men are certainly well calculated to change the whole aspect of a wide country, since every stroke of the axe tells.

Drove out ten miles to the southward with Mr Holmes, to pay a visit to the president of the State Agricultural Society, who farms in Prairie Rond, one of several little round prairies which stretch along the southern borders of Michigan. The small prairies in this State indicate that there is something peculiar either in the soil or climate which is unfavourable to the growth of wood. These peculiarities are still more fully exhibited to the westward, where an immense area of prairie land exists. The physical causes contributing to the formation of prairies have been much discussed. I shall by-and-by give my reasons for supposing that the chief element that has operated in producing those treeless regions is climate.

The road over which we drove was a plank one, and ran through a thinly-timbered oak forest, growing upon light sand and limestone gravel. The boundaries of Prairie Rond were as well defined as if it had been the bed of an ancient lake. It was about five miles in diameter, and almost as level as a bowling-green, but rather higher in the centre, which has made it quite dry. The upper stratum of vegetable mould is about 16 inches in depth, and

consists of a dark-coloured sandy loam; the subsoil of a lighter coloured loam, resting upon gravel or clay. This kind of soil, being apparently rich in those earthy and alkaline matters which plants require, seems to be well-nigh inexhaustible. Crops of Indian corn, wheat, and oats, are raised for many years in succession, without any manure being applied; but the soil gets very loose when constantly kept under tillage.

The president's farm is 160 acres in extent, and two young men performed all the labour. On this he cultivates 60 acres of wheat, and 60 of Indian corn every year. These crops are often taken alternately for a great number of years. A peculiarity in the mode of raising Indian corn was seen on this farm. It was planted in rows, at intervals of 8 feet, and the distance between the plants in the rows from 6 to 8 inches. This admits of the land being completely cultivated by the plough in summer; and wheat can be sown early in autumn, and grubbed or harrowed in long before the Indian corn is harvested. In fact, while I was there, the wheat was thickly matted over the ground, and a waggon, drawn by a horse, was going down betwixt the rows of corn, and a man on each side was pulling off the large ears, and throwing them into it. The stalks of Indian corn were standing as before, and would do so until the spring, and afford some protection to the wheat-plant against the high winds that sweep across this country in winter. Even when Indian corn was cultivated in 3-feet rows or squares, the wheat was growing among the withered stalks from which the grain had been taken. Thus, although labour is very high, and the crops of winter wheat do not average more than 14 to 16 bushels, yet they are raised at comparatively little expense in alternation with maize, which yields from 45 to 70 bushels to the acre.

The young layers of red clover were particularly thick and vigorous. When a field is seeded for grass, it is allowed to remain for two or three years, which serves to solidify the soil, and render it better adapted for winter wheat. Around some of the fields the finer pasture-grasses were growing very luxuriantly, and producing a fine herbage.

The president was from home; but his daughter, a very pretty and intelligent girl, acted as hostess. All rise early in America, and dinner is usually served up about noon. There are seldom any soups in private houses, and no liquor is seen stronger than coffee; the table, however, was loaded with most substantial viands, followed by a great variety of dessert. As no warning had been given that strangers were coming, this would be their ordinary fare. The Americans are usually good cooks; and great mechanical skill has been displayed in adapting the kitchen stoves for cooking, which renders this operation less sweating and suffocating than it often is at home. I do not think that our fair hostess had any help to pre-

pare our excellent dinner; but things went on so smoothly that the cook and the lady were thoroughly combined in her person. After having had some good music and native airs from our entertainer, Mr Holmes and I found our way in the dark to Kalamazoo, highly pleased with our visit to Prairie Rond.

After bidding adieu to Mr Holmes, to whom I feel myself under great obligations for his attention, I left next afternoon by railway for Chicago on Lake Michigan, a distance of one hundred and forty miles. The line runs through a long stretch of "oak openings," which were the finest specimens of this peculiar kind ot forest growth that I saw; and what made it more interesting was the circumstance of its being almost untouched by the axe of the backwoodsman. Where oak-openings occur, the soil is dry and gravelly, and the surface is undulating—a feature which seems common to most of the gravels in Europe or America. The oak trees are thinly distributed over the surface, and the distance at which they grow from one another seemed so regular, that one might have supposed that a skilful forester had been employed to plant them. The crooked trunks are usually about a foot and a half in diameter, and, clear of branches, from 20 to 25 feet from the ground; after that they are forked, and have no great abundance of branches. They have altogether a gnarled appearance. The soil seemed to be too dry and gravelly to support a denser growth; for on the ridges they were from 30 to 40 yards apart, while in the hollows, where the land was moister, the trees were pretty thickly planted. The contrast is very striking between the densely-wooded sands and gravels of New England, which are the very types of sterility, and the stunted growth of the trees on the better soils of the oak-openings. The climate of the Western States is not nearly so propitious to the growth of trees as that of the Atlantic sea-board, on which the rains at certain seasons of the year are more abundant.

Oak-openings, I believe, do not occur farther eastward than Paris in Upper Canada, where the soil is somewhat similar to the oak-openings of Michigan. It is generally supposed that the prairies and oak-openings are the result of the Indians formerly firing the country every year for hunting-grounds. The blackened mould of the prairies is no doubt partly due to the charred vegetable matter from fires which so frequently ran over them. But in the oak-openings there is little evidence of fire being concerned in their formation, for the colour of the vegetable mould is of the same fine hazel tinge which prevails in the oak-forests of Ohio. These gravelly soils can only support a limited number of trees, and the waste of vegetable matter from decay has always been about equal to the annual growth; so there is no accumulation. I have no doubt that soils of similar quality to those in Michigan would produce dense forests in Vermont. It is rather curious that the deficiency of rains occurs principally in winter,

which appears to be the most marked peculiarity of the climate of the North-Western States. The following figures are taken from the reduction of observations by the Smithsonian Institution:—

Fall of rain at Gardner, in the State of Maine—average of sixteen years.

Spring.	Summer.	Autumn.	Winter.
10.6 inches.	10.3	10.5	10.1

Fall at Fort Snelling, Minnesota Territory—fifteen years.

Spring.	Summer.	Autumn.	Winter.
6.8 inches.	10.2	5.7	2.0

The North-Western States are also more liable to protracted periods of drought, which, Dr Henry suggested to me, might originally have destroyed the forests with the assistance of fires; and when the grass and various plants had once got possession of the land, they would prevent the seeds of the forest-trees springing up. The best prairie lands, so far as I could judge, had an unctuous clay in the subsoil, and such is, no doubt, most conducive to the growth of grasses. On the other hand, in the great western prairies there are usually stunted oaks, with the scrub oak as an undergrowth, of the same character as in the oak-openings, growing upon all the gravelly eminences which are not favourable to the growth of the grasses; and, consequently, one generation of trees after another maintain their hold upon these knolls, and often appear like islands in the grassy wastes. On the prairie knolls, as in the oak-openings, there is no great accumulation of vegetable matter from the growth of timber; but where the soil is more propitious to the growth of grasses, an immense accumulation has taken place. I have often wondered at seeing the enormous depth of mould even on some of the tops of the rounded wave-like eminences that prevail in the prairie region.

The Swedish traveller, Kalm, relates that the prairies were, even in his time, less productive of pasturage, in consequence of the cattle having extirpated all the best grasses, which he tells us were annuals. The cattle, he remarked, did not allow the seeds to come to maturity, and hence they disappeared. I thought this was rather a curious statement when I saw it, as annual grasses do not predominate in natural pastures; and Professor Warder, of Cincinnati, assured me that the statement of Kalm was not correct. But the perennial grasses of the natural prairies are rapidly disappearing under pasturage, as well as the great variety of wild-flowers with which they were at one time adorned in early summer.

For twenty miles before reaching Chicago the country becomes a dead level, rising only a few feet above Lake Michigan. It is damp and marshy, and covered with coarse rank grass, which cattle do not touch in summer. It was rather late before I arrived at the town, and the night was very dark. The long withered grass was on fire in several places, and the flames, from 4 to 5 feet in height, were advancing in a line extending for several miles in length, and it was altogether a most magnificent sight. On arriv-

ing at Chicago there were upwards of twenty omnibuses waiting to convey the passengers to different parts of the city, besides as many waggons for luggage. The town apparently had risen so rapidly that no time had been got to pave the streets, which were almost impassable, until a broad street covered with planks was reached. The hotels were huge and elegant structures, and very similar in their management to that of the first-class establishments in the eastern towns.

The wharves at Chicago were crowded with steamers, and the immense piles of goods around the railway stations bespoke the general plethora in trade and commerce. Indian corn, wheat, wool, beef, and bacon are the chief exports. For some time in the autumn of 1855 one million of bushels of wheat were delivered weekly in the town. Several vessels have taken in cargoes in the harbour and gone direct to Liverpool. The greater part of the wheat is of secondary quality, as it is nearly all sown in spring. I observed small steamers having machinery fitted up for taking grain out of one vessel and putting it into another. They were also made available for lifting it out of the vessels and storing it into granaries. The wages of common labourers, being from 4s. 6d. to 5s. a-day, act as a great stimulus to economise manual labour.

One afternoon I had a drive out into the country for a few miles with a manufacturer of reaping-machines. He went out to make a trial of one in cutting the withered prairie grass, and really it did its work remarkably well. He informed me that he had manufactured 700 of these machines last year, and would make as many this. The level prairies are admirably suited for reaping by machinery; and where labour is so scarce and high-priced, the reapers have been a great boon to the prairie farmers, many of whom cultivate very extensively.

In returning to the town I was quite surprised to see so many handsome villas in the suburbs along the shore of the lake. The best houses are made of sandstone, which is the finest I ever saw: it is close in the texture, and almost as white as marble. The rise of property around the town has been enormous within the last four years. Land two miles out along the lake-shore sells at £200 per acre, and some in the suburbs as high as £2000. The progress of Chicago has been most remarkable; and, unless San Francisco in California, no town in America has risen so rapidly. It only contained 4479 inhabitants in 1840, and now there are nearly 80,000, about double the population of Toronto in Upper Canada. This amazing growth has been stimulated by the formation of railways and canals through the immense tract of rich prairie country, which offers to be the most productive region for grain in North America. The facilities which now exist for transporting the produce of the interior have already tapped its agricultural capabilities, and hence the commercial prosperity that has arisen in

exporting that produce, and in importing and circulating the large amount of the other necessaries and luxuries of life, which the inhabitants of a rich and newly-settled country invariably consume. Thus in the free States that possess a good soil and an easy outlet for the produce, numbers of thriving towns often rise up like mushrooms; all classes live well; and the vast majority dress well; and if countries ever had a golden age, Upper Canada and the Western States are now enjoying theirs.

A FEW NOTES ON LAND-DRAINAGE: ITS PROGRESS AND PROJECTS.

THE progress and projects of an art upon which the future of an improved and increasing cultivation of the soil so intimately depends, must always possess high interest to all those connected with agriculture, who are desirous of witnessing a further and fuller development of its resources and powers than even the last twenty years—striking and important as the results of these have been—have evolved. Although the subject is one with which our readers are presumed to be intimately acquainted, so far as the practice of the generally received systems is concerned, still we conceive that a notice of the most recently published or introduced modifications of the old, or the principles of new systems, may not be uninteresting; to these we propose to prefix a few notes on the progress of drainage-operations in the kingdom during the last few years. The greater portion of these remarks may be considered as a digest or *resumé* of a very important paper—and discussion thereon—read before the Society of Arts, a few months ago, by Mr J. Bailey Denton, on "the Progress and Results of the Under-drainage of Land in Great Britain." The matter brought forward in this admirable paper, and the opinions elicited during its after discussion, may be said to have exhausted the subject, and to have been the means of placing on record the practice of the best of our practical agriculturists and drainage engineers. As our remarks have reference chiefly to what may be called "recent improvements" in, or "suggestions for modifications" of practice, and not as a notice of opinions on received systems, we refer the reader to the republication of the paper and discussion, which may be had of G. Bell, publisher, 186 Fleet Street, London, for 6d.

In glancing at the progress of the art, and the amounts expended during the last few years, Mr Denton draws attention to a fact which exercises a material influence upon its future progress—a fact "well known but too little reflected upon"—that high prices of grain are apt to cause the landlords to abate in their zeal for improvement, and this at a time, unfortunately, when the best interests of the community demand that every exertion should be made to increase the capabilities of the soil. When prices rule low, improvements are carried more heartily out. In support of this opinion Mr Denton cites the experience obtained by the expen-

diture in drainage under the Government loan. Thus in 1852, when wheat was 40s. 9d. per quarter, £412,269, 15s. 6d. were expended. But in 1853, when the wheat rose to 53s. 3d. per quarter, the drainage expenditure was reduced to £334,115, 13s. 3d.; and again in 1854, when the price rose to 72s. 5d. the quarter, the drainage expenditure fell to £316,220, 7s. 4d. Taking into consideration the fact that the carrying out of permanent and systematic drainage must be the work of the owner, not of the occupier of the soil, this state of matters is the more to be regretted, and involves questions of grave consideration to the community. Up to a period dating in point of fact a few years ago, draining—being a simple operation, and carried out at a comparatively trifling cost—was very generally looked upon as one of the ordinary departments of husbandry, to be carried out by the farmer himself, independently of the aid of the landlord; but the value of which—inefficient as was the principle on which it was conducted—was sufficiently recognised as an improvement to be paid for by compensation between an ingoing and outcoming tenant. The investigations of scientific men, and the extraordinary results of improved practice, gave a wonderful impetus to the art of draining, and fully—at least pretty generally—convinced agriculturists of the value of the system of deep-draining. As this, however, involved increased expense, increased difficulties arose in the way of the farmer carrying out drainage-works on his own responsibility, and at his own cost. Taking, for instance, a case—numerous enough in heavy wet land districts, where the capital employed in the cultivation of an acre of land was £6—it is evident that the occupier cannot from this take £5 to drain each acre permanently and efficiently, leaving £1 only to carry out *all* the other processes of his farm. Indeed, as Mr Denton remarks, the proposition for tenants alone to incur this outlay is a "practical absurdity;" for the amount of capital generally employed in the cultivation of inferior lands is too little to secure even fair treatment of the land in the ordinary processes, far less to allow of any portion of it to be sunk for the extraordinary process of draining *permanently and efficiently*. The importance, however, of the subject, led many interested in the progress of agriculture to devise some means by which the occupier could have his land drained by the owner or some third party advancing the money; the only burden being the payment of sundry instalments, or a slight increase to his work. Hence originated the system of "drainage loans" and "drainage companies." The first public act was that of Mr Pusey, which was passed in 1840: this, from the complexity of its clauses, remained inoperative, but was followed by the "Public Money Drainage Act" in 1846. The public loan being now all expended, the means of borrowing money for drainage purposes are as follow: (1.) The Private Moneys Drainage Act (12 and 13 Vict. cap. 100); the time for repayment under this Act being twenty-

two years. (2.) The West of England or South-West Land Draining Company's Act (11 and 12 Vict. cap. 142): under this a landowner may charge his estate in perpetuity. (3.) The General Land Drainage and Improvement Company's Act (12 and 13 Vict. cap. 91): under this the term of repayment is fifty years. (4.) The Lands Improvement Company's Act (16 and 17 Vict. cap. 154): under this the term of repayment is twenty-five years. All these acts have established the principle, "that under-drainage was the legitimate work of the owner, and that the only contribution to be made by a tenant should be the payment of the annual instalment by which the cost may be repaid in a given number of years." Beyond establishing this equitable arrangement between landlord and tenant, the obligation, enforced on the borrower of the money, to show that "the improved annual value shall exceed the amount of annual charge by which the cost of drainage shall be repaid," furnished a very wholesome and just criterion, by which every landowner may be guided in the outlay of his own money in draining. "In fact," continues Mr Denton, "the principle involved in this obligation shall be made the rule in every case of improvement. It is not sufficient that the owner spending his own money should get simple interest—he must get so much more than interest as will enable him to establish, if he thinks proper, a sinking fund to repay him his capital within the period for which the work will last, or the projected improvement is not worth doing."

In connection with this system of borrowing money for land-drainage purposes, a very important point, so far as the tenant is concerned, is the time over which the repayment is to be extended. Coincidently, however, with the extension of the term must be that of the durability of the work; hence the necessity of having it done under the direction of experienced men, and in the best possible manner. "It is manifest that the extension of the art of draining will very materially depend upon the rate of instalment charged upon the tenants; and however unprofitable individual cases of drainage may be shown to be, the benefit to the nation will be unappreciable, unless we satisfy the tenants generally that, during all the vicissitudes of times, they can afford to pay all the increased rent they are to be charged. The advantage of a lengthened period will be shown by comparing the increased rent a tenant would have to pay to liquidate the expenditure of £5 per acre in fifty years and twenty-five years. In the former case the increased rent would be from 4s. 6d. to 5s. 3d. per acre, and in the latter from 6s. 6d. to 7s. 2d.; the difference is nearly fifty per cent. Now if drainage is substantially done, there is no reason whatever to doubt that it will last fifty years; and it follows, therefore, that the time of repayment may extend, if need be, to that period."

In drawing attention to what has been, and what yet remains to be done, in the matter of land-drainage, Mr Denton says, that, in order to obtain a clear understanding on the point, it is necessary

to divide geologically the whole country into three great characteristic areas; viz. (1.) The western and north-western, or alpine district of primary and transition rocks; (2.) The middle district of secondary strata, exclusive of, and up to the lower margin of the chalk; (3.) The eastern and south-eastern district, comprising the chalk of the upper secondary strata, the wealden and the tertiary, and post-tertiary deposits overlying the chalk. The following table shows how each district is made up:—

First or Alpine District.	Second or Middle District.	Third or Eastern District.
Cornwall.	Devon, Somerset, Dorset, } parts of.	Dorset, Wilts, Berks, Hants, Oxford, } parts of.
Devonshire, part of.	Gloucester, Monmouth, Worcester, Salop and Wales, } parts of.	Bucks and Beds, } parts of.
Somersetshire, do.	Lancashire, Yorkshire, Northumberland, Westmoreland, Cumberland, } parts of.	Cambridge and Hants, } parts of.
Wales, do.	Durham.	Hertford.
Monmouth.	Scotland, parts of.	Middlesex.
Worcester.	Lincolnshire, Norfolk, Cambridge, Huntingdon, } parts of.	Surrey.
Hereford.	Bedford, Buckingham, } parts of.	Sussex.
Salop.	Oxford, Berks, Wilts, } parts of.	Kent.
Lancashire.	Warwick.	Essex.
Yorkshire.	Northampton.	Suffolk, parts of.
Northumberland.	Rutland.	Norfolk, do.
Cumberland.	Leicester.	Lincoln, do.
Scotland, part of.	Nottingham.	Yorkshire, do.
Outlying portions in the Midland Districts.	Derby.	Outlying portions on the western side.
	Stafford.	
	Cheshire.	

These districts may be defined by lines drawn as follows: A curved line drawn from Exeter to Berwick will make a very close "give-and-take" division between the middle and the western district; and the lower margin of the chalk, commencing at Weymouth in Dorset, and ending at Flamborough Head in Yorkshire, will form a defined boundary between the middle and eastern districts.

The following tables, in connection with these districts, will be of interest. The first shows the amount of land capable of cultivation, the amount of wet land, the extent still to be drained, and the estimated amount of capital required for this. The second table shows the advances made for drainage purposes under the various Acts:—

TABLE No. I.

DISTRICTS.	Total extent.	Extent cultivated, and capable of cultivation.	Proportion of wet land.	Amount of money expended under the Public Money Drainage Act.	Amount of money expended under the Private Money Drainage Act.	Estimated amount of money expended by Incorporated Companies.	Estimated extent of land drained permanently by borrowed money and by private means.	Extent still remaining to be drained.	Estimated amount of capital required.
	Acres.	Acres.	Acres.	£	£	£	Acres.	Acres.	£
Western and North-western,	26,894,280	16,320,890	8,025,000	1,276,020			500,000	7,525,000	35,000,000
Middle, . . .	18,882,600	17,613,610	10,415,000	1,130,000	128,723	350,000	415,000	10,000,000	50,000,000
Eastern, . . .	10,575,120	10,024,000	4,450,000	122,663			450,000	4,000,000	20,000,000
Total, . . .	56,352,000	43,958,000	22,890,004	2,528,783	128,783	350,000	1,365,000	21,525,000	107,000,000

TABLE No. II.

	Public Money.						Private Money.					
	Applied for.			Expended.			Sanctioned.			Expended.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
England,	1,940,227	11	6	1,059,804	0	0	292,056	0	0	111,098	0	0
Wales, .	123,863	0	0	44,297	2	1						
Scotland,	2,491,167	16	6	1,424,682	17	6	72,083	0	0	17,625	0	0
	4,555,258	8	0	2,528,783	19	7	364,139	0	0	128,723	0	0
To expend, . .				1,471,216	0	5						
Total amount of Loan,				£4,000,000	0	0						

Thus we see (says Mr Denton) that there will still be required £107,000,000 for the under-drainage of Great Britain, towards which the balance in hand of the Government Loan, £1,471,216, is applicable, leaving the sum of £105,528,784 to be provided from private sources. Of this it may be assumed that four-fifths, or about £80,000,000, will be required on loan, and that the collected capital of incorporated drainage and insurance companies will be the future source of supply; for it is hardly to be supposed that the Legislature will again sanction the advance of public money for the particular benefit of one class of the community, after experience has shown that private companies are able and willing to lend money upon the lowest rate of interest ruling in commercial affairs.

The sum of £80,000,000 appears large when placed in juxtaposition with the Government Loan of £4,000,000, but when compared with the sums expended in other national enterprises, such as the £286,068,794 expended within the last twenty-five years by railway companies, it cannot be so regarded, particularly if we remember that 3½ per cent is above the average interest now gained by railway investments; whereas in drainage advances not only would the capitalist be made secure of the current interest by a first charge on the freehold itself, but both the owners and occupiers of land would derive a permanent advantage from the enterprise, in which they practically run no risk, and advance no capital. And while this result would be gained by individuals, the community would be benefited by an increase in food, by drainage alone, which cannot be estimated in the aggregate at less than 5330 quarters of the several kinds of corn which constitute the country's produce.

We now propose to glance briefly at the modifications or improvements in drainage practice, recently, or comparatively recently introduced. In his paper, Mr Denton classified the various methods adopted as the "shallow," the "deep," the "combined system of deep and shallow," and the "Keythorpe system." As to the comparative merits of the two first systems, we assume our readers to be well informed. We shall confine ourselves, therefore, to a notice of the two last, adding thereto a description of what may be termed a still greater novelty in practice than either of those,—namely,

the "absorbing bored wells," or "negative artesian well" system, now being introduced into this country by the German engineer, Augustus Edward Bruckmann. Before, however, noticing these systems, we think it may be interesting to glance at one explanation offered by Mr H. T. Thompson in the discussion on Mr Denton's paper, on a point which has been often disputed, but which, when fully proved, has puzzled the first authorities,—namely, that in certain cases "deep drains begin to run after rain sooner than shallow ones." Mr Thompson, stating that the explanation offered by Mr Parkes and others to account for the phenomenon not appearing satisfactory to him, he had had a number of glass tubes made of different lengths and filled with soil, and had tested the times at which they began to drip when water was poured in them all at the same moment. The short tubes, which represented shallow drains, if filled with dry soil, began to drop first. If, however, before all the water poured in had passed through, more water was added, they began to drip immediately, without waiting for the water last used to pass through the soil. This, Mr Thompson thought, was due to the elasticity of the air confined between the free water at the bottom and that at the top of the column of earth; and in this case all the tubes, of whatever length, began to drip at the same moment. But if the tubes, after the first application of water, were allowed to stand some weeks, the soil in the short tubes became dry, all the water being discharged. In the long tubes, however, the soil still retained a little free water at the bottom of the column of earth, so that when water was poured in at the top, this free water was *immediately* discharged, and the deep drain or long tube began to run. The contrary was noticed with the short tubes or shallow drains, as they did not begin to run until the whole column of earth was saturated with the water, or the water percolated through the soil from top to bottom. Mr Thompson stated, that by "tracing the course of the free water in its passage through long and short columns of soil, he had derived great instruction as to the action of deep and shallow drains, and satisfied himself that there was no fear of making land too dry by deep draining, except on peat soils."

After this digression, which may not be altogether uninstructive, we proceed to follow out the arrangement we have already detailed. And first, as to a notice of the "combined deep and shallow drainage" system, introduced by Lord Wharncliffe. In this system, a series of deep 4-feet drains is laid down at a distance of from 18 to 20 yards apart; other drains, laid at a depth of 2 feet (this being considered by the introducer as the limit of cultivation), and at a distance from each other of some 8 yards, are led into and communicate with the deep drains. These shallow drains are not placed parallel to the deep ones, but at an acute angle, or across the field, and at their mouths are either gradually sloped down

to meet the deep drains at their lower level, or have a few loose stones placed in the intervals between the two, "sufficient to insure the perpendicular descent of the upper stream through that space, which can never exceed, or indeed strictly equal, the 2 additional feet." The following, as stated by Lord Wharncliffe, in his paper in the *Journal of the Royal Agricultural Society*, is the principle upon which the plan proceeds:—

In order to secure the full effect of thorough drainage in clays, it is necessary that there should not be only well-laid conduits for the water that reaches them, but also subsidiary passages opened through the substance of the close subsoil, by means of atmospheric heat, and the contraction which ensues from it. The cracks and fissures which result from this action are reckoned upon as a certain and essential part of the process.

To give efficiency, therefore, to a system of deep drains beneath a stiff clay, those natural channels are required. To produce these, there must be a continued action of heat and evaporation. If we draw off effectually and constantly the bottom-water from beneath the clay, and from its substance, as far as it admits of percolation, and by some other means provide a vent for the upper water, which needs no more than this facility to run freely, there seems good reason to suppose that the object may be completely attained, and that we shall remove the moisture from both portions as effectually as its quantity and the substance will permit.

According to Mr Hunt, who, we understand, has superintended the carrying out of the plan at Carleton, the property of Lord Wharncliffe, "the combined system has succeeded most admirably. . . . . The rapid manner in which the surface has become dry after the heaviest falls of rain, has quite surprised all parties who have witnessed the effects of the combined system of draining at Carleton." On the other hand, Mr Denton—who may be considered the advocate of the principle of *depth* in drainage—deems the combined system as a mere compromise of the principle of depth, and says, "The drains of the greater depth must detract from the utility of those at the less, and the two directions, *with* the fall and *across* it, cannot both be right." Comparative cheapness is said to be one of the advantages arising from the system; but in view of the great advantages arising from a more thorough pulverisation of the soil to a much greater depth than hitherto adopted, and which there is every prospect of the farmer being able to do, either by some such plan as the Yester deep land-culture, or by the power of steam, the policy seems doubtful of adopting any plan in which drains placed at so trifling a distance beneath the surface as 2 feet form an essential part. This objection holds with even greater force to the "Keythorpe" system, in which the drains are sometimes so much shallower. We now proceed to describe this system, which, as Mr Denton remarks, is "brought before agriculturists with the flattering recommendation of cheapness and scientific treatment." According to Mr

Trimmer, the well-known geologist, and the able exponent of the system, the principle upon which it proceeds is as follows: Between the soil and subsoil there are certain irregularities, forming a series of furrows. An idea of these may be obtained by supposing a series of artificial ridges made by the plough in an impervious clay district, and these to be covered by a soil of a more pervious and loose character. It is obvious that water percolating through the loose upper soil would reach the furrows or spaces between the ridges, and be led along these to places at a lower level. Pipe-drains are led across or transversely to these furrows —those intercepting the water which percolates through the soil to the furrows—these acting as *minor* drains, while the pipe-drains are the *sub-mains*, so to speak. The method by which these subterranean channels or furrows are known or found out is as follows: "the drainer must dig numerous trial-holes to find the point at which water enters, the height to which it rises, and the relative height which it maintains with respect to the holes above it. He then puts a drain at the greatest distance from his upper hole that he has ever known, to free it from water; and if that does not succeed, he puts in another, and sometimes a third. They were then enabled to effect the draining of a certain area with fewer drains than by the system of parallel drains at equal distances. A saving of from 30 to 50 per cent was effected in the cost of drains over intervals of 8 or 10 yards." The following is Mr Denton's statement of the characteristics of the system, with his opinion as to its efficiency:—

Firstly, That the drains are neither equidistant nor of regular depth, their position and depth being determined by the shape of the subterranean undulations and the depth of the furrows. Secondly, That the drains cross the line of greatest descent (obliquely) in order to intercept the water flowing down the furrows referred to, "which are generally found," Mr Trimmer says, "in land with a considerable fall, and run in most cases in the direction of the fall." Thirdly, that the efficacy of the drainage depends upon a precise knowledge of the breadth and depth of the ridges and furrows. Without (continues Mr Denton) venturing to deny the statement of so sound a geologist as to the existence of these subterranean ridges and furrows, and without presuming to deny that Lord Berners has rendered his land dry for the time being, I am content to state what appears to me insuperable objections to the general adoption of the Keythorpe system. The first is, that the depth of the drainage must necessarily depend upon the depth of the furrows, whether they be 18 inches or 10 feet deep (if they are found to exist of sufficient regularity to become applicable as drains at all). We have the evidence of what has been done at Keythorpe (the property of Lord Berners), showing that they are sometimes found to be only 18 inches deep, one-tenth of the drains being that depth.

If, therefore, Lord Berners should follow the example of the Marquess of Tweeddale, and determine to subsoil this drained land next year to a depth of 22 inches, he would not only plough up all his 18-inch pipe-drains, but

inasmuch as he would decapitate and deform the ridges alternating with the furrows (which are his minor drains), the destruction would not be limited to the 18-inch drainage, but would extend to the major part of the work. The second objection is, that the direction of the pipe-drains is across the fall of the land, and therefore opposed to the influence of gravitation; and the third is, that there exists no tangible data generally applicable for setting out the drains.

On the other hand, there are not wanting excellent authorities who think highly of the system. Thus, Mr C. Wren Hoskyns, the well-known author of *Talpa, or the Chronicles of a Clay Farm*, states it as his belief that the system is one in which "the science of geology was made to assist the labours of the drainer, and that a great reduction of expense was effected by its application." Mr Mechi also expressed his gratification at the "complete and economic drainage" effected at Keythorpe. We find also Lord Berners himself thus expressing his opinion of its advantages: "He did not wish to assume that his plan was the best; but he asked every farmer, and every one interested in draining, to go and see his farm, and he would show them 2000 acres in Leicestershire effectually drained at a cost of L.1 or L.2 per acre. In Suffolk and Norfolk, also, in a 10-acre field, he had more effectually drained it by an additional outlay of L.1 to L.2 an acre, than by a previous outlay of L.10, L.15, or L.20." Mr Robert Baker (of Writtle, Essex) states that when he visited the spot, "it had been raining almost incessantly for nearly sixty hours previously, and when almost every field had become more or less submerged in water, not a drop was observed stagnating upon the drained portions of his lordship's estate." Finally, Mr Trimmer recommends it as a system based on "both science and practice—the generalisations of the former were confirmed by the operations of the latter."

The space at our disposal being limited, we must refer the reader interested to the report already alluded to for further information on this system, and proceed to the description of that now being introduced into practice in this country, and known as "negative artesian wells," or "absorbing bored holes."

Artesian wells, as generally known, are perforations of comparatively small diameter, carried down to a considerable depth in the soil, and communicating with some subterranean source of water, which ascends up the perforation to the higher level. These may be called "positive artesian wells." On the other hand, what are called "negative artesian wells" are perforations which absorb or lead away water *from* the surrounding soil. The introducer of the system, Dr Bruckmann, states that strata which supply (that is, "positive"), and strata which absorb (that is, "negative"), are frequently found in all countries, and in all geological formations, to alternate with each other. Suppose a swamp or lake resting on

an impervious bottom of clay or clay marl, and under this "an irregularly fissured deposit (say limestone or sandstone), the veins or cavities of which communicate with deeper-lying springs, a lake, a river, the sea, or a slope of a hill, even if the distance should be a considerable one. Now, if the upper compact bed, which in nature may offer an alternation of different strata, is perforated, and the hole in the lower situated deposit carried down to a ramified cleft or cavern, then the immediate consequence of this operation must be, that the water of the lake or swamp rushes down in the bore-hole, is carried away, and the latter will be drained sooner or later, according to the capacity of absorption of the cleft and the diameter of the bore-hole." Fissures will not be always met with in boring negative artesian wells; subterranean currents of water, of a certain sectional height, partly filled with sand and pebbles, &c., will often be met with, which will engulph and carry off the waters to be drained. Even the strata of sand, gravel, sandy marl, &c., Dr Bruckmann observes, possess in many cases sufficient absorptive capacity to carry off waters led into them by bores, provided always "that their ends, as in all negative strata, crop out either on or near distant slopes and ravines, or discharge the water into lower situated caves, seas, lakes, springs, rivers, &c., or at least communicate with the later in some way, although, perhaps, very complicated."

With reference to the geological strata in which negative artesian wells may be established, Dr Bruckmann states as follows:—

In all the so-called normal or sediment formation (*diluvium*); the *tertiary* deposits (pliocene, miocene, and eocene); the *chalk formation* (as, *e.g.* chalk and chalk marl, upper greensand and gault, lower greensand or neocomien); the *Jurassic rocks* (Weald clay, Hastings sand, and Purbeck beds, Portland oolite, and sand and Kimmeridge clay, coral rag and calcareous grit, Oxford clay and Kelloway rock, great oolite, Stonesfield slate, fuller's earth and inferior oolite, and the black Jura or the strata of lias); the *trias* (red marls and keuper sandstone, gypsum, muschelkalk or shelly limestone, and new red sandstone); the Permian system (magnesian limestone or zechstein, lower red sandstone or rothe-todte-liegende); the carboniferous deposits (coal fields or measures, millstone grit with coal, carboniferous limestone with coal, sandstone, &c.); the Devonian or old red rocks (old red conglomerate, cornstone, sandstone and marls, and Devonshire limestone and slate); the upper and lower Silurian deposits (Ludlow rocks, Wenlock limestone, Caradoc sandstone, Llandeilo flags, and Cambrian slates); Cambrian slaty or primary rocks (slaty graywackè, chlorite and mica slate, and Longmynd, Skiddaw, &c.); nay, under certain conditions, even the igneous rocks (granite, &c., basalt, greenstone, porphyry, serpentine, syenite, &c.); *for in all these formations* currents of water move in a negative and positive direction, all more or less fissured, and partly contain cavities extensively ramified. Either they are fissured by the contraction of their masses, which were liquid in former times, or they are fractured in various directions in consequence of disturbing forces which have acted upon them.

It is but right to state that since Dr Bruckmann published his remarks on this system of drainage, several parties have directed the attention of the public to the fact that they have advocated or at least described the system for which Dr Bruckmann takes some credit to himself as the introducer of into this country. Amongst others, Mr Ansted, the well-known geological writer, states that in his work on geology the system is fully described and illustrated. Mr Hyde Clark also draws attention to the fact, that so long ago as 1840 he published an account of the system as practised in France, and threw out suggestions for its adaptation to districts in the neighbourhood of London. Mr Denton, in a recent letter to the *Journal of the Society of Arts*, designates the name "Negative Cartesian Wells" as a "very learned title, and a very common practice;" and says, "I presume that Dr Bruckmann is unacquainted with the fact that 'swallow holes' are, and have been for many years, a frequent accessory to under-drainage in this country, and that it is a practice very much to be condemned, where the fall from the drained lands will admit of a quick and certain discharge without them. At page 17 of my paper on 'Land-Drainage and Drainage Systems,' I mention that, in several parts of England, advantage is taken of absorbent sub-strata, by concentrating the under-drains to sumpts or holes, called 'swallow holes;' but this practice appears to be open to objection, in consequence of the frequency with which the drainage-water will rise and cover the surface of the ground (*and destroy the crops growing there*), when the substratum refuses to absorb the water discharged from the drains with sufficient rapidity. I have known swallow-holes resorted to in various parts of England . . . . but they are not economical, except where there is an incapability of fall." These remarks will show that the point adverted to is more the fact that Dr Bruckmann can scarcely claim the merit of introducing the system into England as altogether new, than that it is not applicable or worthy of the attention of agriculturists. Mr Denton even admits that there are some circumstances in which it *may* be economical. Dr Bruckmann, who seems to have had large experience in the system, has taken up his abode at Brighton, in order to introduce the system more widely.

As to the future prospects of "land drainage," it seems, to say the least, doubtful whether its progress will be aided by the attempts, so pertinaciously made by some, to carry out a uniform system for all classes of soils, and for all peculiarities of districts. Land is not like cotton, which can be carried through one unvarying series of operations; and as, in our textile manufactures, one material requires a different machine to work it from another, which difference in mechanism must be ascertained by direct experiment, so must the nature of the soil be ascertained, and the conditions necessary to insure efficient drainage be deduced therefrom, before any one

system is finally adopted. Hence the value of landowners instituting experiments, as suggested by Lord Portman at a recent meeting of the Royal Agricultural Society, with a view to assist their tenants, who are not generally able to pay to ascertain the best methods to be adopted. And seeing that experience points out that the peculiarities of one field or part of a field may be no index to those of another in the same farm, or even at another part of the same field, we agree with a recent correspondent of the *Mark Lane Express*, that it should "be laid down as a principle, that each experiment can only determine the drainage quality of the soil on which it is made," and that "the depth, distance, and rise of drains should in every case be settled by experiment on the small scale, before the general work of draining a field, farm, or estate is commenced on every different kind of soil."

With reference to this important department of experimenting, the editor of the *Mark Lane Express*, in a recent number, has some most suggestive remarks. In insisting upon the necessity of attending to two points generally lost sight of in agricultural experiments, the manner of *conducting* them, and the manner of *describing* their results, he directs attention to the anomalous position occupied by agricultural nomenclature, comparing the confusion connected with it to that of Babel, where different terms were used to denominate the same thing—one calling that a brick which another termed mortar. "Everything," he says, "in draining and cultivation, is admitted to depend on the nature of the soil; but scarcely two men describe the same soil by the same name. We talk about sands, loams, and clays, but rarely with the same meaning attached to the same terms. In a district of sand, for instance, a light loam will be called clay, while in a district of clay it will be called sand. . . . One of the first requirements, then, in agricultural experimenting, is a definite nomenclature for soils which shall be generally intelligible." The same writer draws attention to the fact that "geological maps," as generally constructed, do not, as is generally imagined, give the key to the nature of the soil. They show the inquirer that "within certain areas he will find a certain group of fossils which he will not find elsewhere," and are in this way very valuable "for the purpose of grouping and classifying the endless and bewildering succession of alternate beds of different composition." But as they do not give the clue to the nature or extent of superficial deposits of clays, sand, loam, and gravel, which constitute the bulk of our soils and subsoils, "they are valueless for the practical purposes of agriculture." If these maps are required to show the "depth, composition, and distribution of the superficial deposits," much has yet to be done by agricultural geologists and drainage engineers before "land-drainage" can be put upon a scientific basis, affording data by which the various classes of soils can be drained, with the maximum

amount of efficiency, and the minimum amount of pre-examination and pecuniary expenditure. In this, then, as in other departments of scientific agriculture, we see that, much as has *been* done, more yet remains to *be* done. We have as yet made but a few onward steps, and the direction in which we mean to make that rapid progress desiderated at once by business policy and business exigencies, must be ascertained, not, as has hitherto been so much the case, by empirical dogmas and hap-hazard conjectures, but by painstaking research and careful experiments—rather by sound reasoning founded upon facts, surely, however slowly obtained, than by flashy dogmatic assertions, and hastily-jumped-at conclusions.

THE TRADE AND COMMERCE IN EGGS AND POULTRY.

By P. L. Simmonds,

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In the Note-Book, page 707 of the *Journal* for March 1855, it was remarked, "poultry is far too much neglected by our Scotch farmers." Unfortunately, the reflection is of more general application, and to some extent also applies to English farmers. It is, indeed, too true that the poultry are kept merely to supply the house with eggs, or to furnish a dish for the table, without any systematic view to profit; and in very many cases, from want of proper attention, an egg is a rare commodity in a farmer's house for a considerable period of the year.

In noticing the food of London in the last number of the *Journal*, poultry and eggs were again adverted to; and it may therefore be useful to complete the data, and amplify the statements then advanced.

The subject of poultry-breeding has often been discussed in these pages. There will be found a paper in the eighth volume of the *Journal*, p. 509; and Mr England's prize essay on the rearing and management of domestic poultry was published in the fourth volume of the *Transactions*.

Without even glancing at the recent poultry mania, which has been productive of little or no benefit to the general interests of the poultry-breeders, but was taken up more as an expensive hobby and source of amusement by certain classes, I propose confining myself chiefly to the commercial aspect of the question, and furnishing a few statistical details for the consideration of the farmer.

It is still a mooted point with many, whether the rearing of poultry in this country be a profitable source of industry or not. I am inclined to think that it is; and my impression is fortified by very many returns and balance-sheets appearing in the Agricultural Journals from time to time, showing the comparative

receipts and payments. Without, however, going specifically into this as a business question, it will certainly be well to place before your readers the figures indicating the extent and magnitude of the trade, foreign and domestic, as far as can be gleaned from the returns and estimates available for reference.

It has been well observed that poultry is a kind of stock which fits in readily with other animals, consumes produce which would otherwise be wasted, requires little space, and yields a return during life as well as when killed for the market. The counties of Bucks, Norfolk, Cambridge, Herts, Kent, and Surrey derive large profits from their supplies of eggs and poultry to London. From three to four million head of poultry are annually sold in the metropolitan markets. Why, however, should we be so dependent on the Peninsula and the Continent? Why should we receive supplies from such distant quarters as Egypt and America, when our domestic produce could be so considerably increased?

To the grain-producing farmer it may be doubtful whether the probable profit on raising poultry will compensate for the annoyance and depredations committed on his seeded fields; yet if blessed with a thrifty housewife, the largest grain-farm may derive some considerable return from a poultry-yard. Barn-yards will afford an ample supply of food for poultry during many months of the year, since few farmers thrash their sheaves so thoroughly as not to leave sufficient grain for feeding and fattening fowls and chickens. There are, however, many persons not extensively engaged in cultivating the cereal grains, who can give to a poultry-yard all due care and attention, rearing poultry of various kinds for sale, and obtaining from the occupation a very large profit. This source of advantage is the more promising when we consider that the large consuming centres are all within a day's reach (or less) by rail or steam, from most of the producing localities. Commerce owes much to the influence of steam, but agriculture is scarcely less indebted to the same power. Immense pens of poultry and crates of eggs are purchased in the Irish markets, and shipped by the steamers to Glasgow, to Liverpool, and Bristol. Taking everything into account, and examining all the advantages derived by cheap and rapid transit, the producer of food profits, perhaps, as much by the steam-ship and the locomotive as the manufacturer of clothing. As articles of luxury in crowded cities, poultry and eggs usually command high prices, offering inducements for their propagation to all who can make the needed arrangements, and cause a small share of attention to be given to the yards. Eggs, chickens, and feathers are the principal sources of profit from poultry. When we come to investigate our foreign supplies, we find poultry, in the official trade-returns of imports, so mixed up with rabbits and game, that it is difficult to get at the precise amount of poultry alone received from abroad. The total declared value of the col-

lective imports in 1854, under this head, was £38,876, of which three-fourths came from Belgium; France and Holland being the other countries from which the supply chiefly came.

Poultry are much in demand at the principal sea-ports as live-stock for passenger-ships. Domestic fowls, turkeys, geese, and ducks are brought to Liverpool, not only from the surrounding rural districts, but in immense numbers from Ireland and Wales. Large flocks of turkeys and geese are driven along the turnpike roads from Liverpool to Prescot, St Helen's, Warrington, Manchester, &c., and also exported for ships' stores. Great quantities of dead poultry are also forwarded by railway in crates and hampers to London and the manufacturing districts. The total number imported into Liverpool in 1852, dead and alive, according to the calculations of Mr Braithwaite Poole, the manager of the London and North-Western Railway, rather exceeded in number 3,000,000 head, in weight 4000 tons, and valued at £150,000.

The same able statist, in his "Statistics of British Commerce," estimates the average annual production of poultry, &c. in the kingdom, including the imports, at

	Tons.	Value.
Poultry, ...	14,000	£340,000
Eggs, ...	75,000	3,000,000
Feathers, ...	685	57,500
	89,685	£3,397,500

His estimate of the average annual sales of poultry in the two principal City markets of London is as follows:—

	Leadenhall.	Newgate.	Total.
Fowls, dead, . .	1,266,000	490,000	1,756,000
Fowls, alive, . .	45,000	15,000	60,000
Geese, dead, . .	888,000	114,000	1,002,000
Ducks, dead, . .	235,000	148,000	383,000
Ducks, alive, . .	20,000	20,000	40,000
Turkeys, dead, . .	69,000	55,000	124,000
	2,523,000	842,000	3,365,000

The aggregate number of eggs consumed as food in the United Kingdom, it is impossible to state with any degree of accuracy, but it may be roughly computed at 2,500,000,000. In the last agricultural statistics of Scotland, poultry were not returned, and therefore we have no data upon which to estimate either numbers, produce, or value of the poultry-yards in Scotland.

We have imported from various countries, in the last seven or eight years, the following quantities of eggs:—

	Number.
1848, . . .	88,012,585
1849, . . .	97,745,849
1850, . . .	105,689,060
1851, . . .	115,526,246
1852, . . .	108,281,233

	Number.
1853,	123,450,678
1854,	121,966,226
1855,	100,005,200
1856, (First 6 months.)	68,062,600

In the eight years ending with 1847, the number of eggs imported annually ranged from 96,000,000 in 1840, to 77,500,000 in 1847. The annual quantity now imported is nearly twice as large.

The value of the poultry imported in the first six months of the present year was £15,674, against about £18,000 in the corresponding six months of last year. The number of eggs was nearly 14,000,000 in excess of the number received in the first six months of 1855, but not so large as in 1854. In the metropolis, the egg-trade is a very important branch of commerce, giving employment to sixty egg-merchants and salesmen on a large scale, exclusive of the number of shopkeepers who sell eggs. These salesmen distribute the boxes of eggs over the various consuming localities in light carts.

The imports of eggs in 1854, and the quarters from whence we received them, were as follows:—

	Number.
Belgium,	10,415,517
France,	104,126,918
Portugal,	419,806
Spain,	5,983,161
Channel Islands,	794,400
Other parts,	226,424
Total,	121,966,226

Up to the 8th August 1854, eggs were entered by number; but since that they have been entered by cubic feet, internal measurement. In order to reduce the whole to a uniform standard, 200 eggs are estimated to be packed in one cubic foot. The computed real value of the eggs imported, at 4s. 6d. per long hundred (120), is about £18,005. The duty charged is 8d. per cubic foot of eggs from foreign countries, and half that duty from British possessions.

From 1835 to 1846 the annual value of eggs exported from Belgium was only about 170,000 francs; but in 1847 it began to increase rapidly, and in 1852 amounted to 800,000 francs; in 1853, to 1,200,000 francs; and in 1854, to 1,450,000 francs.

The number of eggs shipped to this country alone from Belgium has been as follows: In 1850, 7,966,417; in 1851, 5,720,142; in 1852, 4,599,604; in 1853, 6,741,026; in 1854, 10,402,407.

The value of the poultry and game we receive from Belgium averages £21,000. In 1854 it was about £25,000.

Quantities of Portuguese eggs are occasionally imported into England by the Peninsular mail steamers. The eggs of the Spanish fowls, being very large, are much esteemed, and valued

at 1d. to 1½d. each. Spain imports a certain quantity from the French province of Oran in Algeria. The eggs of the Bedouin fowls are sold in the European markets at 5d. to 6d. the dozen.

Although we have not the latest returns of stock before us from Ireland, the quantity of poultry kept was returned as follows a few years ago: Number of head of poultry in 1847, 5,691,055; in 1850, 6,945,146; in 1851, 7,470,654; in 1852, 8,175,904.

The supplies of eggs sent from Ireland to Liverpool, and thence into the manufacturing districts, are enormous, frequently exceeding one million a-day. They are packed with straw in crates, boxes, or hampers. The crates contain from 6000 to 8000 eggs, the boxes about 2500. Sometimes large boxes contain 13,000 or more eggs.

According to the Customs Bills of Entry, the eggs imported into Liverpool from Ireland in 1852 were as follows, in weight equal to 9260 tons:—

	Packages.	No. of Eggs.
Dublin,	20,995	69,280,000
Drogheda,	4,019	15,536,000
Dundalk,	1,896	14,774,000
Sligo,	1,285	10,272,000
Cork,	1,272	10,176,000
Londonderry,	1,272	10,176,000
Newry,	1,273	9,664,000
Waterford,	649	4,736,000
Belfast,	669	3,360,000
Ballina,	20	160,000
	33,350	148,134,000

Ireland produces at least five times this amount of eggs.

A great increase in the trade in eggs from Londonderry to the Clyde seems to have taken place within the last few years. About 2000 tons of eggs were imported in two months this year, and chiefly sold in the Glasgow markets. Assuming that there are 22,400 eggs in each ton, this would be a sale of 44,800,000 eggs in sixty days. Taking the population of Glasgow at 400,000, and supposing them all locally disposed of, this would give about two eggs daily to each person, but large numbers were doubtless forwarded to other districts.

According to M. Legrand, a French statistical writer, the whole number of eggs exported from France in 1835 was 577,000,000. The consumption in Paris he stated at 138 eggs per head; while that of the provinces was fully double this rate, as in some parts of the country, junkets, omelets, and dishes composed of eggs and milk, form the principal items at all the meals. "The consumption of eggs for the whole kingdom," he observes, "is estimated at 7,231,160,000; add to this number those exported, and those necessary for reproduction, and it will result that 7,380,925,000 eggs were laid in France during the year 1835."

Twenty years have amazingly increased the production and consumption of eggs, which have kept pace with the increase of population and wealth and the increased exports to England and the surrounding countries.

M. Armand Husson, in his interesting book on the "Consommation" of Paris, just published, returns the number of eggs consumed in the French metropolis at 175,000,000, or 175 to each head of the population, worth about 6s. The value of the eggs consumed in Paris in 1835 was 5,121,009 francs, or about 4s. 6d. per head of the population. The value of the poultry consumed in Paris in 1840 was £300,000. The value of the eggs consumed in Paris last year would be also about £300,000; but probably three-quarters of a million sterling would be a nearer estimate of the poultry and eggs consumed annually in Paris. The quantity of eggs sold in the principal markets of that city, according to the Octroi returns, far exceeds our entire imports.

The consumption and prices may be judged of from the following figures:—

		Number.	Average Price per 1000.
1847,	.	120,940,724	57 francs.
1848,	.	106,747,222	48 f. 40 cents.
1849,	.	113,587,732	46 f. 70 „
1850,	.	124,597,150	43 f. 98 „
1851,	.	129,732,299	42 f. 69 „
1852,	.	160,000,000	41 f. 35 „
1855,	.	175,000,000	

In 1854 we imported from France 104,126,918 eggs; the average number received, in the four years ending with 1854, from France, was 105,500,000. From her Algerian colonies, France received, in 1853, 1,123,630 kilogrammes of eggs, valued at rather more than a million of francs.

Steamboats and railways have done much to increase and improve the trade in poultry and eggs, in butter and milk, as well as in carcass-meat and fish of all kinds, for the supply of large cities and dense populations in Europe and America, situate far from the chief seats of production or fishing. The poultry-dealers of New York made their appearance on the shores of the great American lakes within a few days after the regular trains were in motion on the Erie railroad. Poultry and eggs were swept away by them at an advance of 25 to 30 per cent on their ordinary value, and a decided stimulus has been given to the rearing of poultry and eggs.

The British-American provinces are now supplying the United States towns with eggs, which are imported, duty-free, under the Reciprocity Treaty. Twelve hundred and sixty dozen eggs from Nova Scotia were entered very recently at the custom-house, Boston, in one day. In the season of 1852, about 8000 barrels of eggs, containing 84 dozen per barrel, were shipped from the

port of Montreal to the United States, and sold at about 8d. the dozen.

According to the official American census of 1840, the value of the poultry in the United States was returned at nearly £2,250,000; it is now probably more than £5,000,000 sterling. The value of the poultry kept in the State of New York alone is about £600,000. It is estimated, from satisfactory returns, that the city of New York expends two million dollars in the purchase of eggs. One dealer in the egg-trade at Philadelphia sends to the New York market daily nearly one hundred barrels of eggs. There are no reliable statistics for the other large American cities; but it is highly probable that, in such towns as Baltimore, Philadelphia, Charleston, New Orleans, Cincinnati, Rochester, &c., the poultry trade may be counted by millions of dollars for each. The American Commissioner of Patents estimated the value of the poultry and their products, in the United States, in 1848, as follows:—

Poultry, . .	11,680,512 dollars.
Eggs, . . .	5,431,500 „
Live geese feathers, .	1,000,000 „
	18,112,012 dollars.
	= £3,622,403.

In 1855 the value of the poultry alone was estimated at £4,000,000. The amount of sales of eggs in and around Quincy Market, the principal place of sale in Boston, for 1848, was 1,129,735 dozen, which, at 9d. the dozen, the average price then, makes the amount thus paid for eggs £42,365; while, from information obtained from other egg-merchants in the same city, the total sales for 1848 amounted in value to upwards of £200,000. The average consumption of eggs at three of the Boston hotels was more than 200 dozen each day, for the year 1848. Although, in the United States, animal food is generally the principal aliment, if but one-half the number of eggs consumed by a resident of Paris be allowed to each citizen of New York, it would require 69 eggs for each inhabitant, or fifty-one and three-quarter millions of eggs annually for New York, exclusive of Brooklyn, Williamsburgh, and other suburban localities of the Empire State, with a further population of 200,000, bringing up the total population to nearly one million souls.

But at this ratio of consumption, what quantity of eggs would be required for our metropolitan population of 2,500,000 in London? Nearly 173,000,000 eggs. Probably fully this amount is consumed; and at one halfpenny each (a very moderate price), this gives a money-value of £360,416 for London alone. Mr Poole's estimate of the total consumption in the United Kingdom, 75,000 tons, at, say 22,400 eggs to the ton, would give 1,680,000,000 eggs. His value of £3,000,000 for these is too low. They

certainly may be taken at the price of 6d. the dozen—for they are never obtainable, by retail, lower—and this would give us an aggregate value of £3,500,000.

I cannot go into a detailed description here of the several varieties of poultry, ranging from the pert little bantam of one pound to the gigantic Shanghai of a dozen or more pounds, with its awkward uncouth form, enormous bones, and comparatively small amount of flesh; nor into the inquiry as to the profits derived from rearing ducks, geese, and turkeys. I may mention, however, as a fact worth noticing, that in Brittany they have a plan of salting well-fatted ducks, and when the flesh has been about a fortnight in a tub of salt with bay leaves and saltpetre, and has acquired a fine red colour, the bird is cut into four quarters, larded with cloves, and put into a pot with some spice, for future use.

A Leicester poultry-breeder thus sums up the objections to the Cochin-Chinas which were recently so popular:—

> They are neither useful, profitable, nor ornamental. Not useful, because they do not come early to maturity; and as fat chickens they will not bear a comparison with the Dorking, which are sent to market at two months old: when full-grown, though capable of being made very fat, they are inferior in delicacy and flavour to every other breed. Not profitable, because they will neither get fat nor lay a larger number of eggs without expensive keeping, for they are great eaters, and have no idea of catering for themselves: when allowed their liberty and a good range, they will not avail themselves of it, but will remain poking about home, which may be accounted for by their coming from a warmer climate. Not ornamental: this may be a matter of taste; but, for my part, I cannot like these great awkward gawky birds, with a crow as hoarse and discordant as a raven's cry, with plumage not gaudy, but blotched with red and yellow.

They are recommended as extraordinary layers, occasionally laying two a-day, and their eggs being very rich. It must be remembered, however, that they will not do this unless very highly fed; or, in other words, if you lay out eighteenpence in food, they will produce you a shilling's worth of eggs.

In Malay, Siam, Cochin-China, and the Eastern countries generally, where food is plentiful and cheap, they thrive well, because they require little care. Fed on rice, they will fatten to an inch thick on the breast. A large trade is carried on with Singapore, Penang, and other localities, where poultry are often supplied at 30s. to 40s. the hundred; geese at 2s. each, and ducks at 8d. or 9d. each. Mr Fisher Hobbs, who has given some attention to the breeding of poultry (as well of pigs, for which he has so high a reputation), thus expresses himself on the result of his experience:—

> He had tried all kinds, and had come to the conclusion that there was no breed of fowls so fit for common farm premises, and which the farmer could call his stock, as the Dorking. He believed it was the best bird to place in the farmer's hands as domestic poultry. No doubt the Cochins had certain

properties; they were good breeders, and produced eggs at a very early period of the year. For that purpose they were good; but when they came to consider the great amount of food they consumed, and the inferior quality of their flesh, he believed, for general purposes, they would not equal the Dorkings. There were other breeds beneficial for certain localities and certain purposes. He thought the Spanish was a nice bird for a gentleman in a town or inn-yard, as it required warmth, and would produce a great number of eggs. It grew very slowly, but, when it came to maturity, was a nice bird upon the table.

The great secret of success in the profitable management of poultry is due attention to their food, housing, and cleanliness. I am not writing a treatise on the rearing of poultry, for of these there are several very excellent ones extant. Besides lime or pounded oyster-shells, sand or ashes, and a copious supply of water, domestic fowls require a large amount of animal food, to make them prolific layers. To this, great attention is paid in France. Mons. de Sora, a large fowl-breeder in the neighbourhood of Paris, is reported to buy up the used-up hacks of the French metropolis for feeding his hens, and he thus obtains eggs every day in the year. This is no great recommendation of French eggs, and is almost as revolting to the delicate stomach as a musty or addled egg. But the chemical elaborations of nature are so manifold, that we scarcely know what have been the constituent elements of much of the food we consume; and the sausage and brawn makers, the preserved-provision vendors, and other preparers of animal food, keep us pretty much in the dark as to the special character of their commodities. Indeed, the French have recently been trying to force horse-flesh again into the category of butcher-meat. M. St Hilaire, M. Renault, and other eminent Frenchmen, assert that the horse, besides his ordinary services to man, can also be made to supply cheap and nutritious food; and even old worn-out hacks will, they say, furnish a superior *bouillon*, a good and very eatable *bouille*, and exquisite *roté*, and a delectable fillet. Such hardy gourmands, enraptured with tough horse-flesh, will ere long be loth to admit poultry as sharers in the feast. M. de Sora's poultry-yards furnish about 40,000 dozen of eggs a-week, at the rate of six dozen for 4 francs, yielding the proprietor a very handsome revenue. He employs about a hundred persons, mostly females. He never allows a hen to sit, and all his chickens are hatched by steam. The eggs are arranged upon shelves and covered with blankets, and each morning a swarm of chickens are taken to the nursery.

The Chinese have vast establishments at Shanghae for the hatching of poultry by artificial heat. The process adopted is a simple but efficacious one, and the heat employed is not particularly great, as the thermometer seldom exceeds 93°. At the principal establishment, the proprietor (according to Mr Sirr's work) affirms that

he frequently hatches 5000 eggs per diem. This may be true or untrue; all we know is, that great quantities of eggs are thus hatched. Neither in England nor America, however, have artificial hatching-machines been found to succeed practically.

Although smaller in size, and not equal to a new-laid egg, the French eggs arrive in pretty good condition, and, if sold off quickly, are well adapted for culinary purposes. Few, however, are wasted; and even when not very fresh, they are sold for frying fish, and to the lower class of confectioners for pastry.

There is no difficulty whatever in testing eggs. Take them into a room moderately dark, and hold them between the eye and a candle or lamp. If the egg be good—that is, if the albumen is still unaffected—the light will shine through with a reddish glow; while, if affected, it will be opaque or dark. A very few trials will show any one the ease and simplicity of this method.

In Fulton and Washington Market, New York, a man may be seen testing eggs at almost any time of the year. He has a tallow candle placed under a counter or desk, and taking up the eggs, three in each hand, passes them rapidly before the candle, and deposits them in another box. His practised eye quickly perceives the least want of clearness in the eggs, and suspicious ones are re-examined and thrown away, or passed to a "doubtful" box. The process is so rapid, that eggs are inspected perfectly at the rate of 100 or 200 per minute, or as fast as they can be shifted from one box to another, six at a time.

Salted duck-eggs are an article in great demand in some parts of the East, chiefly by junks. The Malays salt them as they do their meat; but the Chinese mix a red unctuous earth with the brine, which no doubt stops the pores of the shell and preserves them better. They are put into this mixture at night, and taken out during the day to be dried in the sun, which is, in fact, a half-roasting process in a tropical climate.

Pickled eggs, while they constitute a somewhat novel feature in the catalogue of condiments, are at the same time particularly relishing. When eggs are plentiful, farmers' wives in some localities take four to six dozen of such as are newly laid, and boil them hard; then divesting them of the shells, they place them in large-mouthed earthen jars, and pour upon them scalded vinegar, well seasoned with whole pepper, all-spice, ginger, and a few cloves of garlic. When the pickle is cold, the jars are closed, and the eggs are fit for use in a month afterwards. Eggs thus treated are held in high esteem by all the farmhouse epicures.

An article called condensed egg is now sold in the shops. It consists of the whole substance of the fresh uncooked egg very delicately and finely granulated by patent processes, after the watery particles, which the egg naturally contains, have been completely exhausted and withdrawn, without further alteration of

its properties. It contains all the nutritious properties of the egg in its natural state, and must be valuable to shipowners, emigrants, and others. One ounce of it is said to be equal to three eggs.

Eggs form an item of consumption in some manufactures. Much of the softness of good kid leather for gloves and shoes is said to arise from the use of the yolk of eggs. One leather-factory in Bermondsey uses 70,000 or 80,000 eggs a-year for this purpose. The yolk of eggs is mixed with alum, salt, and flour, in a barrel; and the skins, in one process of the manufacture, are agitated for some time with the mixture. The eggs are obtained from France in the spring, and are kept good throughout the year in brine water. The white of eggs—which is pure albumen—when properly dried, enters into commerce for several purposes in the arts, &c. It is exported in this dry and horny state to the West Indies, to be used in desiccating cane-juice. It is also employed as a glaze, or species of varnish, by bookbinders, confectioners, &c., and as a clarifier for wines and syrups. It is used in photography, and by print-manufacturers at Manchester and other districts. Latterly, however, a cheaper substitute has been found for albumen in the textile factories for the pigment-work of the calico-printer. The colours are required to be laid on the face of the goods in an insoluble condition, so as to give a full brilliant appearance. Recently, Mr Pattison of Glasgow found a more economical substitute in milk, which is largely bought up from the farmers, and used as a vehicle for effecting this process of decoration. This insoluble matter, which the patentee terms lactarine, is obtained from butter-milk, at a price far below that of egg albumen. The late Professor Johnston, in his admirable work on *The Chemistry of Common Life*, gives us a clear analysis of the composition of the egg. Hence we learn that the carbonate of lime of the shell is one-tenth of its weight, the white six-tenths, and the yoke three-tenths. In drying for albumen the egg will lose three-fourths of its weight by the evaporation of the watery particles. In the dried state the albumen is in the proportion of 55 per cent; the fat, 40 per cent; and the ash, when burnt, 5 per cent.

In our consideration of poultry profits we must not omit feathers. White and grey goose-feathers have long been used as a soft and elastic material for filling beds, cushions, and pillows. Poultry-feathers, from turkeys, ducks, and fowls, although less valuable, have their commercial use. It is to be regretted, for the sake of health, that feather-beds are not oftener ventilated or the feathers dried. The value of the foreign feathers we import has risen from £4237 in 1847, to nearly £33,000 in 1854. The feathers of poultry for beds, imported in 1854, amounted to 273 tons, valued, at the average price of £7 the cwt., at £32,846.

The countries from whence we receive our supplies of feathers are as follows:—

	1853. Cwts.		1854. Cwts.
Russia,	3306	...	241
Prussia,	...	...	984
Hanse Towns,	3636	...	1549
Holland,	689	...	1203
France,	545	...	1215
Other parts,	400	...	272
	8576	...	5464

These feathers have been for many years imported duty-free.

We also imported, in 1854, upwards of 12 millions and a half of goose and swan quills, valued at £10,282; the goose quills being worth 15s. to £2 the thousand, and the swan quills £3 to £5 the thousand.

Large quantities of feathers are brought down to New Orleans by the Mississippi river from the interior farms. Sometimes these amount to 3500 bags in the year, as in 1850. In the last two years only about half this quantity was received. The 1377 bags of feathers in 1855 were valued at £10 the bag, making £13,770 for feathers. In countries where much poultry is reared—for instance, geese in Alsace—the quills are employed as manure. On one Magdeburg acre of land, nine to ten sacks, of about 500 lbs. each, are used. Feathers contain the same substance as horn, and consequently possess the same powerful fertilising qualities. In this country neither feathers nor fowl's dung can be obtained in sufficient quantity to be taken into much consideration as manure.

Averaging the value of the eggs, poultry, and feathers, &c. we receive from foreign countries, it is equal to nearly £400,000 per annum; and there is no reason why all these, by proper attention, should not be produced in the kingdom.

The figures and calculations I have given may be taken as approximating closely to the truth, and are sufficient to prove that there is an extensive field open for industry and application in various parts of the kingdom in poultry-breeding. That this department of rural economy is capable of extension far beyond its present limit, and may be exerted to a wide and profitable range, increasing wealth without any appreciable increase of cost, is self-evident; and whether conducted on a large or a small scale, the profits are considerable, and the risk and trouble comparatively small.

VINEYARDS OF THE RHINE.

I BELIEVE it to be true, that Scottish tourists generally experience a feeling of disappointment at the first sight of even the most beautiful part of the Rhine, the Rheingau, from Bonn to Maintz. From what they had heard and read, they expect romantic views and grand scenery while sailing on the Rhine. In the lower and upper parts of the river, the scenery is noway peculiar from any other flat country; but in the Rheingau, the mountainous part, it is certainly peculiar, and unlike what most strangers would expect from a supposed fascinating combination between wood and water. What more, it may be asked, is required for romantic scenery than wood, water, and mountain? What other elements exist in Highland scenery? And yet the Rhine scene is not romantic to the Scottish taste, and Highland scenery is eminently so to every one. Instead of the graceful birch waving its supple sprays against the blue sky far above head, or veiling some bold projecting rock with its long and weeping tendrils; instead of massive woods, crowning the mountain-tops with pointed firs and rounded hardwood trees, backing in beauty and in shelter the grassy lawn, spreading itself out to the river's edge, studded with noble trees of different hues and forms, and stocked with beauteous herds and flocks, and upon which stands, with a composed air among the umbrageous timber, the stately mansion of the proprietor; instead of these elements of river scenery in Scotland, often in connection with portions of cultivated fields, seen in the upland distance, between retiring glens and deep dens, dark with luxuriant foliage, there is nothing in the general scenery of the Rheingau to evidence the careful hand of man, which, when exercised with taste and guided with judgment, gives a finish and a value to the most romantic beauties of nature. Many a noble oak and elm, and stately row of Lombardy poplars, are seen in groups here and there upon the banks and braes, but no grassy glades, no cattle or sheep reposing with composure under the shades of trees, no cultivation to indicate upon what the inhabitants subsist; and little else than tangled underwood, beautiful in itself, indeed, and suggestive of luxuriant vegetation. The blackened ruin of many a castle still stands perched upon the summit of a rock, telling of the feudal strifes and rapine of former days; and many an old neglected-looking village is seen, with melancholy aspect, upon the river bank. To the eye of the English tourist, whose home is in the southern counties of England, the Rheingau, no doubt, possesses the charms of the most romantic scenery, even perhaps as much as that of the Highlands of Scotland.

Cultivation there is certainly here, and to a high degree of perfection, and it is the prevalence of this cultivation which forms the distinguishing feature between the Rhenish and the Scottish scenery; it constitutes the peculiarity above referred to: it is, in fact, the cultivation of the vine-plant which renders the scenery of the Rhine unique, and stamps the river with a peculiar interest and value. Herein consists the true beauty of the Rhine, and in this aspect it may challenge all the rivers of the world. Valuable as the cultivation of the vine is, it is unpicturesque. The idea connected with the vine is elegance of form and value of produce. Such an idea is not realised on viewing the state of the vineyards in passing along the Rhine. Those who have seen the vine in Italy, forming graceful festoons between its supporters, which are generally pollarded trees, or in our own hot-houses, would not imagine that the stunted-looking plants on the banks of the Rhine were the same; they seem more like rasp and currant bushes tied up against low stakes, than the supple and the ready-climbing vine. The plants appear so diminutive from the distance of the middle of the river, that the conviction is apt to be engendered, that the people must be wasting their time in devoting so much of it to the culture of so contemptible-looking a plant. The ground, too, presents a forbidding aspect, narrow strips of which are supported in many places by a succession of dry stone-wall terraces of considerable depth, with here and there large heaps of stones piled up, as if they could not be taken out of the way. No large breadths of ground are to be seen from the river. A nearer inspection, however, among the vines themselves, leaves a very different impression from a distant view, of the value of the plant, and of the extreme care and attention bestowed on its cultivation. It is then at once seen that the stunted mode of treating the plant is the best way of directing the force of its sap to the formation of the largest quantity of fruit. The culture is scientific, and has been established by experience.

The English tourist, accustomed to a flat country, cannot but feel strong disappointment in sailing on the Rhine where the banks are low, for they are just too high to prevent passengers on the deck of the steamers from seeing the flat country beyond that contains the richest description of soil and vegetation. It must be owned, however, that in any circumstances the Rhine is a noble river, sweeping its majestic course towards the sea at the high rate of four miles in the hour, its bosom floating many a craft and raft, and its banks at certain points affording solemn and romantic scenes, not to be seen anywhere in Britain. It is, besides, the great highway for the commercial trade of Southern Germany.

The culture of the vine extends along the banks of the Rhine from Bonn to Basle, a stretch of not less than 230 miles, following the bendings of the river. Besides the Rhine, some of its tribu-

taries also form the sites of vineyards, as the Ahr, the Mosel, the Main, and the Neckar. A breadth of a mile or two on each side of the river constitutes the country of the vineyards. What may be the area occupied by vineyards on the Rhine and its tributaries, it is impossible for me to determine; but an estimate may be made of those upon the Rhine itself. The distance from Bonn to Basle is 230 miles, and taking only one mile of breadth, from each of its banks, in a continuous line of that length, the number of acres occupied by vineyards will be 312,800. No doubt, in some parts the vineyards extend more than a mile from the river, but at other parts there are no vineyards at all. Taking in the tributaries, there cannot be less than 400,000 acres of vineyards. I shall confine my observations to the salient points of the vine-culture.

The geology of the country immediately occupied by the vineyards may be stated in general terms from Bonn along the left bank up the river, to Rüdesheim, as the old red sandstone formation; from Rüdesheim to Heidelberg, the transition slates, as clay slate, mica slate, talc slate; from Heidelberg to Baden-Baden, the new red sandstone; from Baden to Freyburg, the transition slates again; and from Freyburg to Basle, primitive rocks, granite, and quartz. From Bonn, on the right hand up the river, there is the old red sandstone to Bingen; from Bingen to Maintz is the active coal-formation, pierced by trap; from Maintz to Weissenburg are the transition slates—clay slate, mica slate; from Weissenburg to Strasbourg are oolitic rocks; from Strasbourg to St Marie is the lower red sandstone; and from St Marie to Basle again are the primitive rocks, granite, quartz, and others. There is thus a very varied geology for the vine to be cultivated upon, and this circumstance is of importance as regards the flavour of the wine, for I believe no produce of the earth is so susceptibly affected by the properties of the soil as the grape.* It is conjectured, not improbably, that a rocky barrier once existed across the Rhine a little below Bingen, which had the effect of converting the entire country above it as far as Basle into an inland lake. Lacustrine shells found in the alluvium above Maintz give support to such a conjecture. The breaking down of the barrier by an earthquake, or the constant eroding effects of water, would make the dry land as it now appears. The barrier has been much reduced by the artificial removal of sunken rocks in the bed of the river.

Mr Cyrus Redding, when referring to the variety of rocks upon which the vineyards of the Rhine and its tributaries are founded, thus gives his opinion of the power of particular rocks affecting the quality of the vine. "Granite decomposed," he says,

* See Geological Map of Europe, constructed by A. Keith Johnston, 1856.

"and quartz in favourable sites, offer good vine-land, and so does sienite. Clay slate, mingled with quartz, is observed to be highly favourable with basalt. Where marl, mingled with pebbles, occurs, the vine succeeds best; nearly the same character, but if anything still a better, may be given to dolomite. Variegated sandstone in decomposition does not so well for the vines in dry seasons, though light in its nature; when mingled with clay, or other earths, its produce is tolerable, but it gives no remarkable wine. Shell marl, where the calcareous properties are most prevalent, when mixed with the clay soil, will grow tolerably good vines, and the same when they are reared upon a coarse limestone well worked. Kiffer produces only weak wine. Schistous marl, where it occurs decomposed, yields a fertile soil for the vine. When mingled with round stones or sand it is favourable, but no remarkable wine is produced from it."* Talc slate debris makes an excellent soil for the vine.

The finest wines of the Rhine grow within a confined zone of latitude. That zone extends only from Coblentz to as far south as Manheim, a distance of only about eighty miles along the windings of the river. Now, the reader will have an idea of the extent of this zone, when I inform him, what he perhaps has not adverted to, that Truro, in Cornwall, is on the same parallel of latitude as Coblentz, and the Lizard Point as is Maintz. In so far as the latitude is concerned wine ought to be grown as easily in Cornwall as in the Rheingau, and so no doubt it could be, were it not that the wide Atlantic Ocean greatly modifies the temperature of Cornwall, placing it below the point required for the ripening of the grape. Grapes require an average temperature of 77° Fahr. for about six weeks to ripen them thoroughly for the production of wine—a temperature much above what we are accustomed to in our island.

The annual rearing of the vine-plant is not attended with much difficulty. When a piece of ground is chosen as the site for a vineyard, it is subjected to a regular course of cultivation with mangold-wurzel, corn and clover, when it is of sufficient extent to allow it. On narrow stripes of ground, and on terraces formed of built walls, the spade must do all the work at once. The vines are planted in the ground in rows, north and south, so far asunder as to allow a labourer to prosecute the work of cleaning between the rows, and to pass between the plants in the rows. As long as the vines are young and small, root crops, as mangold-wurzel, are cultivated between the rows to assist in enriching the soil and screening it from the heat of the sun. The plants, as they grow up, are tied to upright stakes, 4½ feet high, driven into the ground at each vine, by means of rye-straw twisted by the hand

* Redding *On Modern Wines*, p. 200.

into cords. Rye-straw is well suited for this purpose, being hard and durable. The tying up is the work of women. As they farther grow, the vines are properly pruned by the vine-dressers with a knife, in order to direct the sap of the stem into the fruit-bearing buds. Women are as good vine-dressers as men. The prunings are carried home every day to the cows and cattle, which are very fond of them. The ground is raised a little between the rows, to let the rain-water find its way to the roots of the vines. To keep down weeds, which is an essential work, the ground is dug by men between the rows with a two-broad-pronged fork, the weeds being pulled by hand between the plants by the women. The Germans dress their vine-grounds with strong manure, which, as Mr Redding remarks, the French and Portuguese would pronounce injurious. So inaccessible are parts of some vineyards, that the manure is carried to them in baskets upon the backs of the labourers. Roads, however, are made through vineyards for waggons to pass along to carry off the fruit or to fetch manure, and footpaths are so traced as to afford easy access to every part of a vineyard. Each vineyard is enclosed with a stone wall along a public road, and with espaliers of vines along the private roads. Although not generally locked up, it is not easy for a stranger to find access into a vineyard; but particular ones are secured by lock and key. The most common plan of training the vine is against upright stakes, which admit of being worked around them. In some vineyards espaliers are used for training, and they are generally sloped back to allow the vine the greatest benefit of the sun. Some vines are trained to short stakes in a low fashion, parallel to the ground. From what I could observe, the fanciful modes of training seemed indicative of the peculiar notions of particular individuals. A vine requires seven years to reach its period of full bearing, and it may continue to bear well for two hundred years. When becoming barren, by old age or otherwise, vines are rooted out, and young ones are substituted for them, but the ground is primarily put through cultivation to clean and restore its vigour with root-crops and clover. Generally, a certain proportion of the vineyard is always under young vines. When the grapes are fully formed, some of the leaves around the branches are plucked off to allow the sun to ripen the fruit, whilst against the southern end of the rows a screen of straw is put up, or a row of corn sown, to temper the force of the sun from ripening the fruit prematurely. The vineyards are generally small, but the same tenant may rent several vineyards, if he have capital, or purchase their grapes. The keeping of a vineyard in proper order, in its prunings and weedings, requires constant attention. The pruning, less or more, must go on daily in one part or the other, and among the old or the new vines; the great object being to force the fruit to the largest size, and to

the highest and most equal state of ripeness. The women are most industrious in their attendance upon the vineyards, being at work from daybreak to twilight. Working as well as men at these operations, they receive the same wages—namely, a florin a-day, which is twenty-pence of our money. There is strong sense of justice in paying the laborious woman the same wages when she does the same work as the man, and which act of fairness our farmers would do well to imitate. The vineyards are of great variety of form and size; some, like the Steinberg, contain 100 morgens, whilst others are as small as only to yield an ohm of wine —20 gallons. Not a tree is allowed to grow in a vineyard, to acidify by its shade a single grape.

The varieties of the grape cultivated in the vineyards of the Rhine seem innumerable. The most common kind is, perhaps, the Riessling, a small white species, rather harsh in taste, but in hot seasons furnishing a wine with fine bouquet. The Kleinberger is a productive species, and ripens easily. There is also the small Orleans variety, which produces a strong-bodied wine. Grapes have, it is said, been brought to the Rhine from France, Hungary, and Cyprus. Very few red grapes are grown on the Rhine and its tributaries.

The vintage on the Rhine is never commenced until the weather becomes cool, which used to be about the middle of October, but is now often far in November. The grapes, at all events, are never pulled until they are perfectly ripe, and in many vineyards not until they are shrivelled, which practice, no doubt, reduces the quantity of the wine, but enhances its quality very highly. The best grapes in the ripest state are selected to make the wine of the highest class; the remainder makes wine of inferior description; whilst the gleanings with the stalks are reserved for small wine, which ranks with beer. There has been no fine vintage since 1848; a good one before that was in 1846, and since in 1852. A fine vintage is not expected above once in four years, and its fineness is estimated by the quality, and not the mere quantity of the wine. The juice is fermented in large casks, and the fermentation and racking are continued until the wine becomes pure and steady. The wine is made in the villages which are scattered in numbers over the vineyard districts. Cellars are made under the houses, in which the wine is manufactured, and kept in an equable temperature summer and winter. The casks in which the wine is made and kept are very large,—the size, I believe, being fixed by authority, and they are named a stück. Each of them will hold from 1250 to 1450 bottles, according to size. The winemaker generally sells by the large, and the wine-merchant always by the small bottle. It is considered a good return to have a stück of wine from a morgen of land.* Taking the average value

* An English acre contains $1\frac{1}{16}$ morgen (Baden).

of the wine at a florin (20 pence) the bottle, which is near the mark, and the average yield at 1350 bottles the morgen, the value of the wine per acre will be £123, 15s. Take the highest class of Johannisberger, and see the result. It is charged 11 florins a bottle, and the yield is 1450 bottles, using the smaller size, and the value per acre comes to £1462, 1s. 8d., a very handsome income from every acre, even after deduction of the cost of cultivation. What rent should such land pay?

The Rhenish wine is a refreshing beverage, dry, finely flavoured, cheering, and satisfactory. It may be pleasantly drank at any time of day, and it "leaves the bosom and head without disorder." It is to the treatment which the wine receives in making that these good qualities are to be ascribed; and it is it also, it is supposed, which makes the wine so enduring in age, and yet the wine contains no more alcohol than the natural quantity derived from fermentation, which is but little more than 12 per cent. "There is something unaccountable," remarks Mr Redding, "in the extraordinary durability of wines grown so far to the north, when the slightest increase of warmth in a season causes such a difference in the quality of the wine. While strong southern wines suffer from age after a certain period of years in bottle, and begin to deteriorate sensibly, the Rhine wines seem possessed of inextinguishable vitality, and set the greater part in rivalry in keeping at defiance. It is generally found that wines with the lesser proportion of alcohol change sooner than those which are strong. The Rhenish wines averaging so little in spirit, will endure longer, and continue to improve by age as much as the more potent wines of the south, with double their alcoholic strength." It is a common notion of those who occasionally take a glass or two of Rhenish, that it is a sour wine; but they who drink it daily will never say so. Mr Redding states, with truth, that if he takes no more than a glass or two of port, so that the spirit taken with it is not enough to stimulate the stomach, acidity is certain to be felt; but this is never experienced with sound Rhenish wines. I can add my own testimony to the truth of the observation, that Rhine wine is not given to acidity in the stomach; and I would farther suggest, that a wine which permits the cork to be drawn from the bottle, and drank out of it for some days without becoming vapid, must have a naturally good constitution, and such strong affinities between its component parts as to secure it against derangement. This strength of constitution is the antidote against acidity, and the supporter of old age. The freedom from acidity of Rhenish wines is very well illustrated by a writer quoted by Mr Redding:

"The country which borders on the Mosel," says this writer, "produces abundance of grapes, and some of the wines have an agreeable flavour, especially the vintage of Brauneberg. This highly flavoured wine has within the last seven years (this was in 1833) become a fashionable beverage at

the first tables in London, and when iced in summer, nothing can be more grateful. Some of it has the flavour of the Frontignac grape, without its sweetness. This wine has a singular quality; it is difficult to make into vinegar. The author accidentally discovered this property by putting a few bottles into a greenhouse, and afterwards into his cellar, for the purpose of using it as vinegar; but the following spring he was surprised to find that no acetous fermentation had taken place. It has been generally supposed in England that the wines of the Rhine and Mosel are more acid than the white wines of France; but if the above experiment may be a criterion of the qualities of the former, it would prove that they are less acid than Sauterne, Barsac, and the Graves; for it is well known that it is necessary to sulphur the casks of these wines to prevent the acetous fermentation taking place. Acids are supposed to generate gout, and in England Rhine wines are on this account forbidden to gouty subjects; yet the gout is a disease rarely known on the banks of the Rhine, where hardly any other wine is drank. We, therefore, conceive this to be a vulgar error, and that no wine is better for a gouty patient than that of the Rhine; the author can testify this from his own experience, and the testimony (which can be more depended on) of an eminent English physician, who practised at Maintz for many years, and was of opinion that the strong wines of the Rhine are extremely salutary, and that they contained less acid than any other; moreover, they are never saturated with brandy, as the French wines are."

In truth, Rhenish wines are genuine unadulterated wines as yet, whatever they may ultimately become, when subjected to the usages of the south wine-trade, and concocted for the British taste. It is doubtless a high test of British taste, when it prefers concocted wines, from experimental recipes, to genuine ones as they come from the hands of the grower!

The named varieties of Rhenish wine are almost as numerous as the vineyards themselves. One has only to look into a wine-card, in the various hotels, to feel surprise at the number of kinds presented to the traveller's choice. Their very number precludes a choice, for no stranger can possibly make a selection by reading a long list of names. The advice of a friend in such a case is of no use, for he may recommend a kind which you may not relish. The only sure way of acquiring a knowledge of Rhine wine to your own liking, is to drink through the first card-list you fall in with, and then try every new name you may afterwards find. You will thus select one or two you like, and will continue to drink them. Nor is the task formidable, for you can drink your half bottle a-day with impunity. The highest class wines are soon recognised, because they are few, but they are too expensive for daily use. The second class may freely be indulged in at little cost, and there are many of this sort. I believe it to be a good plan to drink the wine in most repute in the locality you are staying in. Many of the lighter wines are excellent, as Kalstädter, which is only 16d. a bottle.

In Britain all Rhenish wines are named Hock, a natural corruption of the name of the oldest vineyard, Hochheim. Hochheimer is an agreeable wine, costs 30 pence the bottle, and the best variety of it is the Dom-Decaney. Of late years a sparkling wine has been made at this vineyard under the name of Moussirender-Hochheimer, the highest quality of which, the Non Pareil, costs 5s. the bottle. It is a delicate, highly flavoured wine, and most persons prefer it to Champagne. It is served in ice in summer upon the table as one sits down to dinner, the cork having been drawn, and yet it retains its vivacity to the end. There are many of this class of Hock. The vineyard of the famed Marcobrunner is on the hill of Strahlenberg near Hattenheim. It has somewhat of a bitter taste, which does not improve on repetition. The wine, however, is full bodied, and the bitterness renders it peculiary wholesome. The vineyard is named from a running spring close to the high-road enclosed in a fountain. Rüdesheim is a considerable vineyard, exactly opposite the town of Bingen. The vineyard is divided into four portions, the Ruland, which is the lowest; the Berg, the middle; the Bischofsberg, the upper; and the Berg Auslese, which is on a rocky eminence, and affords the best wine. The wine is made in the village of Rüdesheim. The Bischofsberg of 1852 realises 3s., the Berg 2s. 6d., the Ruland, having a tinge of red colour, 2s. a bottle, while the Berg Auslese is 4s. This wine has an agreeable, enticing, refreshing taste, and is deservedly in much esteem. On the opposite side of the river, on the hill above Bingen, is the vineyard of Scharlachberg, which yields the Scharlachberger, wine of a quality similar to those we are speaking of. Of the same class is Liebfraumilch, grown around the town of Worms, in the Palatinate above Maintz; and so is the Forster, a very pleasant dinner wine, of which the variety Traminer is most esteemed and most costly. The Brauneberger wine of the Mosel may be placed in this class. It was once in fashion in this country, but the Rüdesheimer maintains its reputation most steadily in Britain.

Of the lighter description of wines, the Niersteiner of the Palatinate is the most pleasant at dinner, but it is surprising how seldom it is to be met with in inns. Of the vintage of 1848 it only costs 10 pence a bottle. Laubenheimer and Deidesheimer are also grown in the Palatinate; the Deidesheimer Traminer being greatly recommended by medical men to invalids. With this kind of wine may be classed the Hattenheimer and Giessenheimer of the Rheingau, made at the villages of those names. Their vineyards are placed along the margin of the river, upon flat ground, from which they have acquired an earthy flavour, and are therefore of inferior value to the wines immediately above them on the sloping ground farther from the river. This class of wine costs from 10 pence to 16 pence a bottle.

But the highest class of white wine is the Johannisberger, Steinberger, and Stein. The Johannisberger, from the vineyard of Prince Metternich at his palace, is out of all comparison, in my estimation, the finest Rhine wine in every respect. This vineyard is a well-known object, with its rising crest, crowned by the white-coloured palace, immediately in the rear of the town of Giessenheim, as viewed from the river. The Schloss vineyard does not exceed 80 morgens, and is divided into four sections, each producing a distinct variety of wine, and that in the front of the palace, containing 25 morgens, yields the highest quality. The grapes are the Riessling, and are allowed to hang until quite shrivelled, and the best are cut off the bunches for the first-class wine. This wine has hitherto not been in the market, being reserved for crowned heads, but may be purchased at the cellars, and I have observed lately that an authorised agency has been established in London for its sale. The bottles are sealed with different coloured wax according to quality, light blue indicating the highest. They are charged 11 florins, 18s. 4d. each, besides bottles and case. The other three varieties cost 9, 7, and 5 florins each bottle. Every bottle has a label, as is common, with a view of the Schloss and vineyard, and signed, which is not common, by authorised persons. In 1854 the signatures to the bottles were Hertzmansky and Przitioda of the vintage of 1846. On a visit to the vineyards of the Rheingau, I had an ardent desire to taste, for the first time in my life, genuine Johannisberger, although I had often met with that name in the wine-cards of inns. Accordingly, I had my desire gratified by a half bottle of light blue of 1846 in the balconied chamber of the second floor of the Schloss facing the river. The day being splendid, the sun bright and hot, time two P.M., the air in solemn stillness, I placed a small table and chair in the open window of the balcony, to contemplate the beautiful and placid scene before me of the noble river at its broadest part, with its numerous islands, and of mountains, vineyards, towns, and villages, with only my loved companion, the light blue, beside me, and none present to mar the enjoyment, mentally or physically. The colour of the wine is brilliant wine yellow, which it is a pity to obscure with green glass. Its taste is a delicate mixture of sweet and bitter, rich, highly refreshing, the aroma meanwhile playfully exciting the olfactory, leaving an impression on the mind cheering and elevating, and desiring repetition. Potential as the wine undoubtedly was, it left no headiness, no idea but that as much might be taken with impunity. Costly and short as the enjoyment necessarily was, I rose quite satisfied I had had full value for my money. A very fine large camera-obscura in one of the windows of the room concentrated the charming view I had been contemplating in a very vivid manner—the steamers plying to and fro, and other craft floating down the stream, or towed up

against it. The corn harvest was proceeding, and many a band of reapers was seen far and near. How beautiful and lively a picture was this compared to any dismal photograph!

The far-famed Steinberg vineyard of the Duke of Nassau lies in a north-east direction from Johannisberg, on the slope of the hill, upon the top of which stands the large convent of Erbach, now converted into a lunatic asylum. It contains 100 morgens within a ring fence. The vaults of the convent constitute the cellars of the wine, which contain a choice collection of the finest wines of the Rheingau. Steinberger is so well known to the British taste that it requires no description. It is delicious, refreshing, but heady when taken to the extent of even half a bottle, and induces nervous irritability. Of the value of this wine, Murray gives an instance in his *Handbook of North Germany*, p. 289. "In the spring of 1836," he says, "half of the finest wines in the Duke's cellars were sold by public auction. The cask which was considered the best, the flower, or as the Germans called it, the *bride* (braut) of the cellar, being Cabinet Steinberger of 1822, was purchased for the enormous sum of 6100 florins, about L.500, by Prince Emile of Hesse. It contained 3½ ohms, about 600 bottles, and the price was therefore equivalent to 16s. 4d. a bottle."

The Stein wine is made near Wurtzburg. It is pleasant and refreshing, but heady. It receives more praise, in my opinion, than it deserves, and is more costly than it is worth.

The Johannisberger of the hotels is made in the extensive vineyard belonging to Johannisbergstadt, a village immediately behind the Schloss. The wine is pleasant, full-bodied, and refreshing, but is charged 5 and 7 florins a bottle at the inns, a price much above its value, but which the growers may exact, in order to maintain a character under the wing of *the* Johannisberger.

The *red* wines of the Rhine are not numerous, yet their cultivation covers a considerable extent of ground. The most famed red wine is the Assmaunhäuser, a pleasant, refreshing, full-bodied wine, not unlike some Burgundies. It is said that the grape of which it is made was brought from Burgundy. The vineyard is really of considerable extent, but being overlooked with difficulty, either by land or water, it is little known. It is placed on a precipitous bank from the river to a height of perhaps 1000 feet, consisting of a series of terraces, some of which are as high as they are broad. Nothing shows so clearly the remunerative culture of the vine as the amount of labour bestowed upon and required by this vineyard, to which every particle of the manure has to be carried upon the shoulders of labourers, and where the soil in many places is obliged to be upheld to the roots of the vine by means of basket-work. This wine fetches as high a price as Rüdesheimer, 3s. a bottle, although the vineyard is not so favourably exposed to the sun; but the soil is peculiarly favourable to the growth of the vine.

The valley of the Neckar yields good red wine, one of which is Kaltstädter, a pleasant refreshing wine, worth 16 pence a bottle. I drink this wine every day, and import it myself, as it is not to be obtained from our wine-merchants. Here is also made a lighter red wine named Affenthaler. The great extent of country from Bingen to Maintz is occupied by raising a red wine named Ober-Ingelheimer, light, and fetching a shilling a bottle. The Ingelheim vineyards face too much north to yield fine wine. The valley of the Ahr yields a red wine, the Walportzheimer, inferior to Assmaunhäuser, but may be classed with Kaltstädter. The red wines of the Mosel are Pisporter and Zeltinger, both inferior to Assmaunhäuser.

The *white* wines of the Mosel are delicate and highly-flavoured, with an unmistakable taste of the grissly Frontignac grape. Sparkling Mosel has long been famed. It is a delicious wine of the first class, but is rather sweet, and the flavour evanescent, and it wants the freshness and body of sparkling Hock (Moussirender). It fetches, per bottle, from 3s. the copper label to 4s. 6d. the Non Pareil. The Mosel wines are all inferior to those of the Rhine.

It is thus obvious that the limited Rheingau (District of the Rhine) is the principal seat of the first-class wines. The best vineyards are few, and possessed by few proprietors,—the Duke of Nassau, Prince Metternich, and the Counts Bassenheim, Ingelheim, and Schönborn.

To witness the care and manner in which a vineyard is managed, it is necessary to go through one with leisure, and the sight is both interesting and instructive. But to see vineyards in their aggregate in perfection, which is an uncommon sight to a Briton, some elevated point should be attained, and the course and beauties of the river can only then be observed. "English travellers are often under the erroneous impression," says Murray, "that they have *seen* the Rhine in passing up and down in a steam-vessel, and they hurry onwards to something beyond the Rhine. It may be said of them, in the words of a homely phrase, that they 'go farther and fare worse.' The views in many places, looking *down* upon the Rhine from its lofty banks, far surpass those from the river itself; and the small valleys, which pour in their tributary streams on the right hand and left, have beauties to unfold, of which the steam-driven tourist has no conception, and which are entirely lost to him." Perhaps the choicest spot from which to see the most characteristic view of the Rhine, in its broadest and narrowest reaches, its most confined and most extensive landscapes, and in the beauty, value and extent of its vineyards, its numerous towns and villages, is from the Rossel Tower of the Niederwald, a wood which the Duke of Nassau lately purchased from Count Bassenheim. The Niederwald is a forest of large oak of much value, felled for the construction of houses, and of beech for fuel.

It extends along the ridge of the hill, from the height above Assmaunhäusen to several miles to the eastward. It forms an excellent screen to the vineyards between it and the river from the north winds. At its western extremity has been erected an artificially ruined tower, the Rossel, perched on the top of a rock, upon the face of which the ruins of the Castle of Ehrenfels seem to cling, and from which is seen on the one hand, a considerable way down, the narrowest part of the river, the Bingerloch, and on the other, the broadest, from Bingen to Maintz, with the entire stretch of vineyards from Rüdesheim to Biberich on the one side, and from Bingen to Maintz on the other, including the numerous islets which dot the surface of the river. Two remarkable phenomena may be noticed from this tower—one is the total exclusion from sight of the vineyard of Assmaunhäusen, though it extends over a considerable area of ground at the base of the rock on which you stand; and the other is, that while the water of the Rhine, in clear green, flows down the middle of the channel, that of the Nahe, a dirty brown, issuing from Bingen, forms a separate stream along the south margin, while that of the Main, a dirty red, forms another stream along the north margin. A similar phenomenon is seen from the Castle of Ehrenbreitstein, where the clear water of the Mosel does not mix with the muddy waters of the Rhine for many miles down. The railroad forming from Biberich to Coblentz may be traced from this height as far as it is yet made and opened to Rüdesheim. Roads and paths are formed at Assmaunhäusen and Rüdesheim, by which the heights of the Niederwald may be easily reached, either on foot or upon donkeys, and guides are ready to point out every object of interest, and answer every inquiry. The Jagd Schloss of the forest is now a house of call, at which refreshments may be had, and bad wine drank, at a cost considerably above that of the best inns of the neighbourhood. With the Rheingau under our feet, the observations of Mr Redding upon the scene, although perhaps somewhat coloured, bear nevertheless much of the impress of truth:—

"Whoever has visited the noble Rhine," he says, "must have felt sensible of the beauty of its vineyards, covering steep and shore, interlaced with the most romantic ruins, towns ancient and venerable, smiling villages, and the rapid broad German river reflecting the rich scenery on its banks. From Maintz even to Bonn, the vineyards of the Rhine are observed to greater advantage than any similar cultivation in other countries: Erbach, enthroned in its vines; the Rheingau, its Johannisberg on a crescent hill of red soil, adorned with cheering vegetation; Mittelheim, Giessenheim, and Rüdesheim, with its strong fine-bodied wine, the grapes of which bask on their promontory of rock in the summer sun, and imbibe its generous heat from dawn to setting. Then, again, on the other side, Bingen, delightful, sober, majestic, with its terraces of vines, topped by the Chateau of Klopp. The river and its riches, the corn and fruit which the vicinity produces, all

remind the stranger of a second Canaan. The Bingerloch, the ruins, and the never-failing vines scattered among them, like verdant youth revelling amid age and decay, give a picture nowhere else exhibited, emitting to the joyousness of wine the sober tinge of meditative feeling. The hills back the picture, covered with feudal relics or monastic remains ; below, Assmaunhäusen to Lorch, mingled with the purple grape. Bacharach is near, the wine of which—probably the fancy of the drinkers of which having changed—is now pronounced second-rate in quality, though not long ago even the French celebrated it in their bacchanalian songs : it is still very good, fashion may say what it chooses. Landscapes of greater beauty, joined to the luxuriance of fruitful vine-culture, can nowhere be seen ; perhaps there is something to be added, for the allowance of wine and its agreeable qualities, with the noble scenery of the river. The mind will have its associations upon all subjects."

THE FARMERS' NOTE-BOOK.—NO. LIII.

Rotation of Crops. By JOHN TOWERS, Ph. Ch., Croydon.—This term implies a certain routine or change of crops on a farm by which (other important operations being duly attended to), the land retains its fertilising quality during its adopted course, producing the allotted crops of that course, without deterioration. Somewhat more than twenty years ago, the renowned professor De Candolle of Geneva took up the subject, and by the way in which he treated it elicited the attention of many practical agriculturists, whose object it was to ascertain the causes of certain known effects. Things remaining pretty much as they were, the inquiry concerning the Theory of Rotation had become less eager, and now, in the year 1856, we seldom meet with any definite allusion to it in the Agricultural Reports which appear weekly in the columns of the *Mark Lane Express*, or in those of the daily papers. But should it even be admitted that the subject of rotation has lost its interest with the agricultural world, it must not be entirely overlooked, for many points of great interest are therewith connected; and now, under that impression, without any farther preface, I extract the following lines from a periodical which has ceased to be published for more than ten years :—*

"Brugmans (the author of some botanical works, among them a dissertation, *De Plantis inutilibus et venenatis*, published in 1783) stated that a portion of the juices which are absorbed by the roots of plants are, after the salutiferous portions have been extracted by the vessels of the plant, again thrown out by exudation from the roots, and deposited in the soil. De Candolle followed up the subject, deeming it trustworthy. He thought it probable that it is the existence of this exuded matter, which may be regarded in some measure as the excrement of the preceding crop of vegetable, that proves injurious to a succeeding vegetation. The particles which

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* LOUDON'S *Gardeners' Magazine.*

have been deleterious to one tribe of plants cannot but prove injurious to plants of the same kind, and probably to those of some other *species*, while they furnish nutriment to another order of vegetables. Hence it *is* why one kind of corn crop is injured by immediately succeeding another of the same kind: hence, why different kinds of crops may with advantage succeed one another: hence, in short, the propriety of a rotation of crops."

When this theory of rotation was first generally promulgated —that is, about the year 1833, under the title of De Candolle's Theory of the Rotation of Crops—I at once took up the subject, believing the theory to be justifiable by a comparison of many established facts; but why was it ascribed to De Candolle? If Brugmans really preceded that professor in point of time, it were more correct to ascribe its annunciation to him. However, not to dwell upon times and seasons, it is but reasonable that they who still are interested in the success or rejection of the theory, should be informed that several other parties, not unknown to science, have advocated the doctrine of radical excretion. Thus Dr Lindley, now Sir John, expressed himself in his *Outlines of the first Principles of Horticulture*:—

"*Spongioles* secrete excrementitous matter, which is unsuitable to the same species afterwards as food; for poisonous substances are as fatal to the species that secrete them as any other species. . . . But to other species the excrementitious matter is either not unsuitable, or not deleterious. . . . Hence, soil may be rendered impure (or, as we inaccurately say, worn-out) for one species, which will not be impure for others. . . . . This is the true theory of the rotation of crops."

Here then, we have the frank avowal by this eminent botanist of the view he took of the excretory theory. But this is not all; a still higher authority may be appealed to: I allude to the late Thomas Andrew Knight, then president of the London Horticultural Society. I received a letter from that gentleman, wherein he wrote: "The Continental naturalists have lately imagined that trees emit some matter into the soil, of the nature of excrement, which subsequently becomes noxious." From the above references, the reader will perceive, that about twenty years have elapsed since the theory of rotation attracted the special notice of physiologists. I may then, without incurring a charge of plagiarism, advert to one publication, the first edition of which was produced in 1830. At page 397, under the head General Remarks upon the Raspberry, there were the following observations:—

"Whenever raspberry plants are removed to another situation, the old ground ought to be well manured, deeply digged, and turned; and then it should be placed under some vegetable crop. By this mode of treatment it will be brought into a condition to support raspberries again in two or

three years. This is a curious and interesting fact, one which proves that it is not solely by *exhausting the soil* that certain plants deteriorate if planted on the same ground year after year; for, if this were the case, manuring would renovate the ground, but it fails to do so; and thus, if pease or wheat, for example, be sown repeatedly on a piece of land, the farmer may manure to whatever extent he may choose, his crops will dwindle and become poor and poorer. This is remarkably the case in the Isle of Thanet, where, to use the local term, if the land be '*over-pea'd*,' it becomes, as it were, poisoned; and if pease be again planted, though they rise from the soil, they soon turn yellow, are '*foxed*,' and produce nothing of a crop. To account for this specific poisoning of the soil, we must suppose that particular plants convey into the soil, through the channels of their reducent vessels, *certain specific fluids*, which, in process of time, saturate it, and thus render it incapable of furnishing those plants any longer with wholesome aliment. In fact, the soil becomes replete with fecal or excrementitious matter, and on such, the plant which has *yielded it* cannot feed; but it is not *exhausted*: so far from that, it is to all intents and purposes manured for a crop of a different nature; and thus, by the theory of interchange between the fluids of the plant and those of the soil, we are enabled, philosophically, to account for the benefit which is derived from a change of crops."*

About the time that the first edition of Liebig's *Agricultural Chemistry* was published, the question of rotation excited the most lively interest; and if I mistake not, that great analyst made particular allusion to the experiments of M. Macaire Princep, a French chemist, made in the hope of being able to collect some trustworthy results, elucidatory of the agency of fecal exudation. He was said to have ascertained the *general* fact by attempting to raise plants in pure siliceous sand, pounded glass, or washed sponge, white linen, and particularly in rain-water. After cleansing the roots thoroughly, he placed them "in pure water. After they had put forth leaves, expanded their flowers, and flourished for a time, he ascertained by evaporation of the water, and the use of chemical re-agents, that the water contained matter which had exuded from the roots." I do not quote the experiments at large, but one in particular, that with the bean (*Vicia Faba*), must be cited.

"The bean grows pretty well in pure water. It was found that the water continued clear, but assumed a yellow tint; chemical tests and evaporation seemed to detect a matter similar to gum, and a little chalk. Another bean was placed in this liquor, and would not thrive; and then, in order to determine whether this was occasioned by the want of carbonic acid, or by the presence of some exuded matter, plants of wheat were placed in the water. They lived well, the yellow colour of the fluid became less intense, the residuum less considerable, and it was evident that the new

* *Domestic Gardener's Manual.* Ed. 1830 and 1839.

plants absorbed a portion of the matter discharged by the first. Hence the practice of cropping wheat after beans is justified by this experiment."

Macaire found that the potato yielded no satisfactory evidence, for it scarcely coloured the water, and gave but little taste. He observed that the experiment would lead to the inference that "the potato is not a very good preparation for corn crops, which is known to be the case in practice, unless it is assisted by an extraordinary quantity of manure."

From what has been stated the reader may ascertain the degree of interest which the theory of rotation had excited at an early period of its existence. That interest, however, declined, and for some years it has remained in abeyance; and at the present time is little spoken of, although in practice it remains as the guiding principle of the best agriculturists.

Theoretically, although I have reason still to consider myself the only English writer who, in point of time, gave publicity to the theory through the medium of the *Domestic Gardener's Manual*, and am by no means disposed to retract anything I have written upon the philosophy of Rotation; yet I must not refrain from saying that its principles may have been by some too exclusively adopted, and carried too far. Perhaps there can be little doubt that when any crop fails, upon repetition, that failure may be attributed to a certain unhealthy saturation of the soil: yet rotation, as a *sine qua non*, and a never-to-be-omitted practice, ought not to be insisted on. They, indeed, who have dared to persist for a time in particular repetitions of one and the same crop, have not experienced a certain deterioration. As to the potato, it is not uncommon to hear of the same ground being planted and replanted year after year for a great period. M. Macaire's experiment with that tuber bears upon the fact so asserted; for it tends to show that it does not produce much radical excretion. It may, however, be inferred that certain plants do give forth a considerable portion of fecal matter from the peculiar odour which their roots impart to the soil, and also from the colour, the change of tint, which ground acquires from croppings. Thus, let newly-turned maiden earth be put into a garden pot, and with it a single strawberry plant. This earth shall, we premise, be of that pale ochrous drab-colour which indicates the presence of iron in the state of protoxide. Yet in one season, how many shades of darker hue will it acquire from the deposition of carbonaceous matter, although it be moistened with filtered rain-water only? Let experimenters, for their own satisfaction, determine this and other phenomena connected with the lately discovered fixation of manures by loamy earths. I now throw out the hint as a stimulus of further investigation. Again—sow pease thickly in a garden pan or box, for transplanting, and mark the strong and peculiar smell which exhales from the dis-

turbed mass. It may be urged that the odour arises from detached portions of the roots themselves left in the ground; but still the odour is a specific *gas*, and gas is an elastic vapour, not a tangible substance. All diffusible odours, however, depend upon gaseous exhalation, and therefore this objection goes for nothing.

Recurring to M. Macaire's experiments, it must be conceded that much ambiguity attends them and their results; for plants growing in water are not in their natural situation, they live—and for a time may grow, but they are not as plants in the field, rooted and established in the soil, and exposed to the stimulus of all the great natural agents: hence the danger of being deluded by appearances. A *cutting* placed in a coloured infusion imbibes the colouring matter, and this had induced some microscopists to believe that they had thus detected the proper channels of the ascending sap; but in fact, *rooted* plants do not so imbibe colour, although the soil in which they grow may have been moistened for a long time with deeply coloured infusions, such as ink or logwood. Plants, in a word, attract and elaborate their proper food: they are their own chemists, and ought to be placed in their own appropriate media of nutrition; otherwise, though life may be protracted, their functions are not duly performed, nor are their secretions regularly and healthily effected.

If any light can, by chemical investigation, be thrown upon the theory of rotation, it must be derived from experiments conducted upon purely natural principles. Cuttings afford fallacious data; even rooted plants in pure water only would not give products exactly corresponding with those excreted in soil. An appropriate medium of growth *might* be found in the finest maiden earth, soaked and washed repeatedly with distilled water. Such a soil, placed in a number of clean-washed garden-pots, each receiving a plant of some kind or other, as wheat, clover, pea, bean, &c. &c., duly preserved under some shelter from hot sun and dashing rains, but moistened with filtered soft water, might in process of time become impregnated with specific radical secretions, which, by a series of artificial rotations, might determine, in some degree, a course of cropping that would be productive of healthy growth, or otherwise, of manifest deterioration. I offer this idea as a suggestive hint only, but one which perhaps might, if followed up, lead to some instructive results.

Does Thorough-Drainage tend to produce Inundations?—The late inundations in France have provoked a keen discussion as to the advantages and disadvantages of drainage. There are no doubts felt as to the great benefits derived from it as an important agricultural operation; but some, who were formerly staunch advocates for draining, thinking that the inun-

dations were caused in some measure by an extensive carrying out of this improvement of late, the acknowledged benefits to agriculture from it being thus greatly counterbalanced by the disastrous effects of the inundations to the country generally, have raised a warning voice against proceeding with the draining of the land without taking steps at the same time for the restraining of the waters of the rivers to their proper channels. They allege that, by reason of the draining all over the country, the water which falls in the state of rain and otherwise is carried off more quickly than formerly, thus producing great and sudden risings in the rivers, and those destructive floods which caused such havoc in some of the finest plains of France lately.

This is a subject in which not merely the agriculturists, but the whole population of France, must feel the deepest interest at present. A spirit of agricultural improvement has been evoked, which the Emperor and his government are doing everything in their power to encourage by example, the awarding of premiums at agricultural shows, loans, and last, but not least, the inviting of the agriculturists of all nations to exhibit their stock and implements in Paris. A loan of 100,000,000 francs has also lately been issued to those proprietors who choose to avail themselves of it for the draining of their estates. And it has therefore become a subject of inquiry with those most interested as to the policy of carrying out the extensive drainage operations likely to ensue from this grant, till it at least has been proved that they will not increase the risk of such inundations as have taken place this summer.

As draining has been more extensively carried out in Britain than in any other country, frequent allusions are made in the discussion to its effects in suddenly increasing the waters of the rivers. There can be no doubt that it is often remarked, in Scotland at least, that as draining has progressed in the country, the rivers have been more subject to sudden floods than formerly. Of this the millers complain very much. But it arises not, we think, from thorough-draining, but from the draining of hill pastures. This latter system of drainage has been as extensively carried out as the former in Scotland, and has been equally attended with the beneficial effects in ameliorating the climate of those districts where it was performed. And it is self-evident that, from drains being made on the surface, the water which fell was allowed neither to sink into the ground nor to stagnate, but was carried rapidly down to the water-courses, thus suddenly increasing the size of the river, and in some districts causing them to overflow their banks.

But we differ from those who think that the same effects are produced by thorough-drainage—that is, by draining land 3 or 4 feet deep with tiles or stones, with distances between the drains of from 15 to 40 feet. Let us inquire what becomes of the water which falls as rain or otherwise on an undrained soil? Part of it

is evaporated, and part percolates through the soil, the amount evaporated and percolating depending on the degree of porosity of the soil and subsoil. But if we take the average of the soils of this country, it is found by experiment that the greater part is evaporated; the water flowing off on the surface, of course, is included in what is evaporated. If we limit the inquiry to a soil which requires thorough or frequent drainage, resting on a retentive subsoil, some of the water will probably percolate only to the depth of the soil, say one foot; and if there are no small veins of porous material to carry it deeper, all the rest will either flow off on the surface, or be evaporated from the place on which it falls. If we open drains on the surface to carry it off, it is plain that a larger quantity will reach the rivers in a shorter time than it did before, causing them to rise more suddenly. This is the case with the first kind of drains, of which we have spoken, viz. the pasture or sheep drains.

Now, suppose we drain the same soil 4 feet deep, with an interval of 24 feet between the drains; then the effect of this will be that none of the water which falls will be carried off till the soil and subsoil, 4 feet deep, will be thoroughly saturated with it, or, in other words, till it has percolated to the drains to be carried off by them. The superincumbent 4 feet of soil becomes, in fact, a sponge or reservoir which holds the water till it is required by the plants growing on the surface, and any surplus water which capillary attraction cannot enable the soil to contain, flows off by the drains. Now, this power to retain water varies with the nature of the soil. Sand, for instance, has been found capable of retaining about 25 per cent of its own weight of water poured upon it when quite dry, and allowed to percolate till it began to drop; while pure clay retained in the same experiment 70 per cent of its own weight; and the intermediate soils of different degrees of mixture of sand and clay retain proportionally more or less water according as the clay or sand predominated.

It is clear, then, that there must be from the soil, when drained, less water carried off than when undrained, by as much as the soil for 4 feet above the drains contains more than the one foot when it is undrained. And not only is the quantity of water flowing to the rivers greater from the undrained than from the drained, but it is carried off sooner and in a shorter time, thus causing a sudden and great rise in the river; for it must be remembered that the surplus water above what the drained soil is able to contain from capillary attraction is not carried off all at once, but flows slowly down to the drains, as is apparent from the drains continuing to emit water some days after the rain has ceased to fall. We have supposed the case where the water gets off rapidly from the undrained soil; but in reality this is not always the case, as there are often obstructions, such as stones, clods, &c., which impede the

flow of the water from the surface, and dam it back so much as to allow no other way for escaping excepting by evaporation. Hence it may be said, that often there is not that rapid and complete flow of the water from the undrained land which we have supposed above. There is some truth in this, but, to counterbalance it, we may mention that, though some of the water may be kept back, there is generally an immense quantity of sand or earth carried down with the water from the undrained land, while it issues clear from the drains; so that, in the former case, the bulk of the streams reaching the rivers will be greater than those in the latter.

Besides, it has been found that, after we calculate what has flown out of the drains, and what has been evaporated, there is still a considerable quantity of the water which falls remains to be accounted for. And we can only do this by supposing that, in its progress to the drains, and when it reaches the bottom of them, it must meet with some porous veins by which it is conducted below the drains, and is thus lost entirely to the rivers, so that, after a fair consideration of this subject, we can come to no other conclusion but that thorough-draining tends rather to prevent than to produce inundations.

It may be asked, if it is true that more water flows from the undrained soil in a shorter time than from the drained soil, what advantages are derived from draining? Now, we have said that when the rain falls, the water percolates to a certain depth in the undrained soil, and there it remains till it is carried off by evaporation, the effect of which always is to lower the temperature of the body from which it takes place. Fortunately we require no argument here to prove this position, as it is found already by experiment that the temperature of a soil, when drained, is always higher than when undrained. Thorough-drainage therefore brings the soil into a state more favourable for the growth of plants. We need not allude either to the prejudicial effects produced by water, which is always found more or less stagnant on undrained land from some cause or other. Again, the physical condition of the soil is much improved by drainage. Instead of being reduced almost to a plastic state in wet weather, and baked, hardened, and rent into large fissures in dry weather, as is always the case with undrained soil, it is mellowed, made friable, and put into a proper state for the spreading of the roots of plants by drainage. We might enumerate many other advantages derived from drainage; but the intention of this paper is not to dilate on this part of the subject, but rather to mention the effects of drainage on increasing suddenly the waters of rivers, so as to produce inundations.

Guano Frauds, and how to detect them.—Agriculturists are greatly indebted to the editor of the *Gardener's Chronicle* for the great trouble he takes in examining into all complaints made to him

of guano frauds, for his fearless exposure of any parties connected with such dishonourable practices, and his justification of those who may have been unfairly suspected of them. A complaint lately made to him against Messrs Gibbs, Bright, & Co. for kiln-drying wet and damaged guano, and subsequently mixing it with the bulk of a cargo, and of course selling it all as good guano, was at once submitted to examination; and the result has been, that not only has that respectable firm been entirely acquitted of the least intention of cheating its customers, but its conduct in the transaction has been such as to justify an increase of confidence in it by agriculturists.

The principal buyers of damaged guano in general are dealers who make a trade of mixing it with rubbish, and selling it at an enormous profit to farmers. The Messrs Gibbs, becoming aware of this, tried to put a stop to the practice by putting the wet and damaged article into a proper marketable state. They consulted therefore with Mr Nesbit the chemist, who undertook to conduct the operation of kiln-drying some guano that had been damaged, by a large vessel laden with a full cargo of it striking the dock sill and breaking her back. The operation was successfully performed. "The dried guano, however, turned out dusty, and was consequently subject to much waste, unless mixed with an equal quantity of good undamaged guano. This was done; the mixture was then analysed by Mr Nesbit's report, who found it of excellent quality. It was afterwards sold according to analysis."

Now, in all this we see nothing but a great anxiety on the part of the importers to prevent any frauds being committed on purchasers by dishonest dealers. It is also satisfactory to know that this wet guano can be dried again without any material loss of the ammonia, if a proper method of doing it be followed. In connection with this, the editor of the *Gardener's Chronicle* exposes the doings of some parties in Liverpool, who prepare a "beautiful stuff, in appearance so exactly like fine Peruvian guano that the quickest eye would fail to distinguish it, and so soft and smooth, and free from grit, that the sense of touch is equally powerless in detecting it. This material is so largely prepared at Liverpool from clay, that two large kilns are constantly at work in drying it, and the whole of it goes into consumption as guano. As a dryer of damaged guano it would be invaluable." The manufacturers of this stuff having a due regard for the caution of the English farmer, and thinking his Irish and American brethren fair game, allege that it is not for the English but for the Irish and American markets it is manufactured. We will be surprised if Jonathan will not be 'cute enough to discover the trick. We quite agree with the editor, that "it is for any market where it can be sold."

A purchaser of guano and other light manures should be most cautious in charging any dealer in these articles with selling an

adulterated article. A case has lately been decided in England, which should be a warning to all farmers not to act too rashly in condemning any article sent them, till they have ascertained by the analysis of a fair sample that the bulk is really adulterated. The case is this: A manure-dealer in England supplied a farmer with guano, with which he was quite satisfied, with the exception of the last 2½ tons. The farmer sent a sample of this back to the dealer, expressing his suspicion of its not being genuine; to which the latter replied, that he had examined the sample, and found that it contained guano and phosphates; he, at the same time, expressed his willingness to have it analysed, provided the farmer would pay part of the expense of the analysis if it was found to be genuine Peruvian guano. After the guano was kept about two months by the farmer, it was returned to the dealer in May, who refused to take it back, stating in his reply to the farmer, "You have kept it two months and exposed it to the air, and the ammonia, its fertilising quality, has escaped." The dealer accordingly brought an action against the farmer for the full price of the 2½ tons of guano. The farmer's evidence depended mainly on the fact that his men, on sowing the stuff, knew that it was not guano, but thought it was something else which their master was trying for experiment,—and on the analysis of Professor Way and another chemist, who both found the sample to contain less than 2 per cent of ammonia, less than 8 per cent of phosphate of lime, 16 per cent of gypsum, and about 50 per cent of sand and clay. The summing-up of the Judge is as follows: "If the sample represented the bulk, it would settle the question; but the case on the part of the dealer is, that it was not an honest sample, because the guano was objected to in March, the bulk was returned on the 29th of May, and in July this sample, without any particulars as to how it had been kept, was sent to Professor Way. The bulk was in the dealer's yard, and if Professor Way had been sent there to obtain a sample for analysis, it could have been decided to a dead certainty; but this sample came from some part kept back, and how it had been used, or where kept, they had no information." The sum sued for by the dealer was £29, and the jury's verdict was in his favour for £29, 1s.

We quite agree with this verdict, and hope that it may have the effect of making other farmers take care as to how they select samples for analysis, when the character of a dealer is at stake. We subjoin here two analyses by the same chemist of samples taken at different times by different individuals from the same lot of guano; and we give at the same time, for the sake of comparison, copy of analysis of a guano of average quality:—

	Average Guano.	No. 1 sample.	No. 2 sample.
Water,	13.45	14.92	11.11
Organic matter and ammonia,	52.36	51.16	53.84
Alkaline salts,	9.13	3.40	3.12
Phosphates of lime and magnesia, with traces of iron,	23.48	24.08	30.40
Silica,	1.58	6.44	1.52
	100.00	100.00	100.00
Ammonia,	17.61	13.87	17.69

The parties who selected the samples were of undoubted respectability. And the only reason we can give for the great disparity in the composition of the samples is, that, in mixing up the portion of the lot from which No. 1 was taken, proper attention had not been paid to having the floor well swept of any sand that may have been lying there. In selecting a sample, a considerable portion of the bulk should be thoroughly mixed, and all the lumps well broken. The lumps are the richest in ammonia, and the powder the poorest, as the following analysis will show of three samples, one of lumps and powder well mixed, a second of lumps alone, and a third of powder alone:—

	Lumps and Powder.	Lumps.	Powder.
Water,	9.9	12.30	10.59
Organic matter and ammoniacal salts,	47.62	65.70	41.85
Phosphates and alkaline salts,	35.38	20.61	32.92
Excess of phosphoric acid,	1.87	...	...
Sand,	5.14	1.39	14.64
	100.00	100.00	100.00
Ammonia,	17.96	23.38	13.21

As it is of the greatest importance for farmers to know some simple method of satisfying themselves as to the genuineness of a guano of which they may be suspicious, we extract the following from the report of the Chemical Agricultural Society of Ulster, by Dr Hodges, the chemical officer of the society, whose contributions are generally most valuable, not merely to the members but to agriculturists throughout the land. As it is more than likely, from what we have heard, that the price of guano is to be increased by £1 per ton next season, there will be greater temptation to adulterate manures, in order to keep down the price to unwary buyers. And hence the advantage to farmers of being acquainted with such a simple method of detection as that recommended by Dr Hodges:—

As it may be occasionally useful that farmers should be enabled to test the qualities of guano, I have, from a careful consideration and examination of various methods proposed for this purpose, devised the following simple plan of proceeding, which, in the absence of facilities for a more extended chemical analysis, may be adopted:—1. Weigh 50 grains of the sample, and dry it completely by placing it in a paper before the fire, or over the water-bath. (A simple apparatus for this purpose is readily contrived by placing a common sauce-pan containing water on the fire, and inverting the lid, upon which the substance to be dried, spread on a piece

of writing-paper, is to be supported and exposed to the heat of the water in the pan kept boiling until it ceases to lose weight.) The loss of weight which is produced by drying the sample, multiplied by two, will represent the amount of water present in 100 grains: of course, the less water present the better the sample. 2. Weigh 20 grains of the dried sample, and spread it upon a piece of thin glass, the size of half-a-crown, broken from the bottom of a Florence-oil flask, and support the glass by means of a piece of iron-wire, bent so as to form a tripod over the flame of a spirit-lamp; or, when a spirit-lamp cannot be obtained, place the guano in a metal spoon, and expose it to the heat of a clear fire. Heat the specimen, either over the lamp or fire, until the blackness, which is at first produced by the charred organic matter, has entirely disappeared. If the residue, after being strongly heated for half-an-hour, is greyish-white, the guano is probably genuine; if it assumes a reddish colour, it has been mixed with earthy matters. Ascertain the loss of weight, which multiplied by five, will, after subtracting the amount of water found by operation No. 1. to be contained in one hundred parts of guano, represent the per-centage of organic and ammoniacal matters. 3. Place a tea-spoonful of the guano in a bottle, add to it about a table-spoonful of quicklime, made into a cream with water; shake the mixture, and observe the intensity of the ammoniacal odour. The stronger the smell of head salts produced the better the guano. 4. Introduce the matter which is left on burning the sample of guano (operation 2) into a tumbler, and add to it a tea-spoonful of spirit of salts, and about half a glass of water. If a brisk escape of gas, shown by the bubbling up of the liquor, is observed, the guano is adulterated (by limestone, chalk, or marly earth). Pour the mixture upon a filter formed from a piece of blotting-paper, or allow it to remain at rest for some minutes, and decant off the clear liquid portion, and wash it from the acid by pouring water over it two or three times. Dry the solid residue thoroughly before the fire, or on the water-bath, and ascertain its weight, which, multiplied by five, will represent the sand and earthy matters contained in the sample. By means of these simple operations, which any person of ordinary intelligence may successfully perform, the character of a sample of guano can readily be discovered. If the purchaser has reason to conclude that the manure sold to him as genuine be adulterated, he should at once forward a sample of it to a chemist, that its actual value may be ascertained. For this purpose, about 2 ounces of the guano will be sufficient, which may be enclosed in a double covering of stout paper, and forwarded by post. The cost for a complete analysis to a member of the Society is only 10s. Farmers should be aware that the sum paid to a merchant beyond what the analysis shows the manure to be worth, may be readily recovered.

The Drainage Act of France.—The following are some of the provisions of this Act:—

1. A sum of 100,000,000 francs is to be appropriated out of the public funds, to facilitate drainage operations.

2. The loans made in virtue of this act are repayable in twenty-five years, by yearly instalments, including both the paying off of the capital and the interest calculated at 4 per cent. The borrowers will be at liberty to pay up the loan before the twenty-five years expire, either in whole or in part.

3. The public treasury is authorised to recover the annuity due, and that current from the crops or produce of the drained lands, a privilege which takes rank after the public taxes. Nevertheless, the sums due for seed, and the expense of the crop of that year, are paid from the price of the crop before the debt of the public treasury.

4. The privilege on the drained lands, such as what is established in the preceding article, is granted: (1) To the syndicats for the recovery of the tax for repairs, and of the loans or advances made by them; (2) To the lenders for the reimbursement of the loans made to the syndicats; (3) To the borrowers for the payment of the amount of the works executed by them; (4) To those who have lent the money to pay or reimburse the borrowers in conforming to the provisions of the paragraph 5 of the Article 2103 of the Code Napoleon. The syndicats have, besides, for the tax for repairs for the past and current years, the privilege on the crops, such as is granted by Article 3. The privilege affects no part of the property within the bounds of the syndicats, excepting that part on which the debt is due.

5. Every person having a right of hypothec previous to the privilege acquired in virtue of the present law, has the right to reduce that privilege at the period of the alienation of the property to the highest value existing at that time, and resulting from the works of drainage.

6. The public treasury, the syndicats, the lenders, the borrowers, only acquire the privilege on the condition of having previously had a report drawn up containing the value of the lands to be drained relatively to the drainage-works projected, the extent, and an estimate of the value after the produce. When a loan is asked from the public treasury, the report is drawn out by an engineer or competent person appointed by the prefect, assisted by a surveyor named by a justice of the peace; if there is a difference of opinion between the engineer and the surveyor, the latter must record his observations in the report. In other cases the report is drawn up by a surveyor appointed by a justice of the peace in the canton where the lands are situated. The borrowers who have executed works for proprietors not constituted into a syndicat, must besides have the value of their works certified within two months of their execution by a surveyor appointed by a justice of the peace.

7. The privilege granted by the present laws on the drained lands is preserved by a registry taken—for the public treasury and for the lenders, in two months from the granting of the loan; for the syndicats, in two months from the order by which they are constituted; for the borrowers, in two months from the report prescribed by the previous article.

8. If an operation in drainage increases the expense of keeping up a water-course already regulated by a law, the drained lands

are to be included among the properties interested and assessed conformably to that law.

A Walk and a Talk through the Agricultural Implement Department of the Crystal Palace, Sydenham.—Although the most pleasing in its associations of all the arts and sciences, and yielding to none in its social and political importance, Agriculture presents an exceedingly anomalous position. For long time it was pursued more as a hap-hazard conjectural art, than one based upon sound principles; and its followers, as a body, were characterised by their dislike to change, and their hearty contempt for all innovations in practice: "it served our fathers' purposes—are we wiser than they?" was a sentiment acceded to by nearly all. And it is only of late years that it has been raised from the indifferentism which characterised it, to the dignity of a truly philosophical pursuit. When science first offered her aid to agriculture, her efforts were sneered at, and the benefits she proposed to bestow were received with general incredulity; but the advantages of the connection are now gratefully and fully acknowledged by her most enlightened followers. But although the "farming" interest views with different interest now the aid offered to it by the sister sciences, and no longer meets it with the "stubbornness and tenacity" which were at one time looked upon as virtues, still it is surprising to note the manner in which the art is *popularly* estimated. Take the opinion of the general population, the manufacturing more especially—the "iron men," as Dickens calls them, the "cotton men," and men of other materials, nameless here—and with nine out of every ten you will with ease discover that their prevailing idea of agriculture—if indeed they have ever deemed it worth a thought at all—is, that it is a matter of jog-trot daily routine, with which science has very little to do; that farmers are "slow," knowing nothing of, and very little influenced by the "fast" whirl of commerce and trade; that a farm can be managed by any one—a tailor from his board and his congenial goose, or a merchant from his counting-house—without any previous training, and with a marvellously small expenditure of knowledge, or business prudence and forethought; that corn *is* grown to some extent on our own British soil, and is cultivated by our own British clodhoppers, but that the great bulk comes from foreign lands, whose foreign owners take in payment for the same—according to a "pleasant fiction" of a certain political school, located not quite a day's journey from smoky Manchester—the "almighty *cotton;*"—all forgetful as they are, according to another pleasant fiction of the same truthful academy, of the charms of the "almighty dollar," or the weight of our "powerful sovereign." It is needless here to speculate on the causes which have led to the popular idea, that the main strength of our nation, and the chief source of her wealth,

is its manufactures and trade, and that agriculture, in its social and political features, has no—or but few—claims to the consideration of the Legislature, or to the gratitude of the people. It is sufficient for us to know that such *is* the prevailing popular idea, and that it exercises a peculiarly baneful influence on the progress of an art in which the nation are intensely interested, know it or not as they will, and in spite of all the protestations of the Manchester or any other political school to the contrary notwithstanding. Knowing this, and looking at the point in all its bearings, we have little difficulty in perceiving the reason why agriculture should occupy the position so graphically described as follows, by Mr C. W. Hoskyns, in his admirable paper at the Society of Arts *On the Progress of Agriculture during the last Fifteen Years*, a position, be it observed, however, which it owes, according to some, to other causes than the one we have alluded to:—

> Whilst other industries and arts, lying in more defined channels, are more readily marked and measured, and every invention and improvement mapped down with a precision not so easily accorded to the progress of a national industry, which, though representing an invested capital, calculated twenty years ago at L.217,000,000, has, for the reason suggested, reached our time with no history, no statistics, no representative in the law or the State ; no board, no minister, no department—in fact, as Mrs Gamp would say, "no nothing." So entirely unnoted and unchronicled is its progress by the State for the public, *or by the public on its own account* [the italics are our own], that if it were possible for me to recapitulate, step by step, all the forgotten facts of its history during the present century alone, and lay them succinctly under the eye, I do not believe there is a single branch of art or industry of which the particulars would seem to form a more novel or eventful history, or more suggestive of surprise that they should have been allowed to drop astern, as it were, in the wake of time, and fade from view ; and this, too, while presenting facts surely as instructive for reflection or foresight as could occupy the attention of the economist or the statesman.

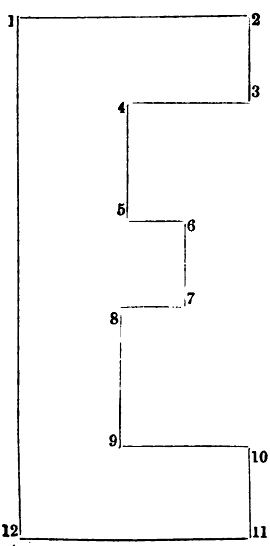
While it is notorious that the general public do not look upon the facts connected with agriculture in this light, as possessing features of such broad interest, socially and politically, and while lamenting this indifference as detrimental to its progress, we do not hesitate to lay the blame, to a large extent, for the existence of such a feeling on the agricultural body themselves. It is certainly true, that if other bodies in the State—as the manufacturing, to wit—had shown the same supineness and indifference to all matters connected with the progress of their respective departments, that little interest would have been displayed by the public, and by consequence little help would have been given them by the Legislature. Had the same energy and perseverance in making the importance of its claims bulk largely in the estimation of the public, been displayed by the agricultural as it was by the manufacturing community—had we numbered our Sir John Sinclairs by scores, we should this day have had a Board of Agri-

culture as well as a "Board of Trade," and "Departments of Practical Agriculture" would now have been dispensing their bounty in teaching young agriculturists, and spreading abroad the sound scientific knowledge of the principles of their calling—just as the "Departments of Practical Art" are doing daily to our manufacturing population. It is an axiom, that what is worth the having is worth the working and asking for; and it is apparently another, which the exigencies of our political life have made clear, that if we ask the Legislature longly, loudly, and pertinaciously, for anything, we shall obtain it. Before the agriculturists have a just claim on the consideration of the general public to the importance of their calling, socially, commercially, and politically, they must first show that they are deeply imbued with this sense of its importance themselves, and endeavour by all the means in their power to give it a public position which shall demand and obtain public attention. The public must be educated for this; agricultural shows, the discussions of agricultural societies, and the labours of the agricultural press, all help in this education; but something more is wanting. If "Mahomet will not come to the mountain," we must endeavour to bring the "mountain to Mahomet." In other words, we must not expect the public to go out of their way to get this information, and to be educated up to the desired point; we must bring our information to them. We must do, in fact, as the manufacturers have done—force our claim upon the public; let them be met with at every opportunity, and the evidence of their importance at every institution or exhibition. It is no light thing we advocate, if the present position of agriculture is a matter of profound regret to all its friends; to place it in another more befitting its true dignity is surely worth their anxious efforts. And it is difficult to overrate the importance of keeping the claims of agriculture before the public in the way we have indicated. What the interest created amongst agriculturists by the establishment of "shows" did for the real advance of agriculture, will public exhibitions, held in places the resort of the *general* public, do for the real advance of public interest in its progress. We venture to say that the interest excited by the department of agricultural implements, and the trial of agricultural machines, at the "Great Exhibition of '51," did more to attract the attention of the general public to the importance of agriculture as a "national branch of industry," than all other efforts made previously—indeed, it opened up to many the fact of the existence of this branch, of which they were nearly ignorant. Hence it is that we look upon the establishment of an "agricultural department" at the Crystal Palace, Sydenham, as an important matter, and one which deserves the attention, and, need we say, the practical assistance, to make it complete, of all interested in practical agriculture. In this wondrous structure, with its still more won-

drous furnishings, thousands of all ranks and classes daily walk, and the mere casual glance at, or hurried walk through, the ranges of implements and mechanism—all of which are called into requisition in the daily work of the farm—must tend to imbue the minds of many, previously ignorant, with some sense of the importance of an art, to aid which so much mechanical ingenuity has been expended. Nor does its value end here: to the student of agriculture it is invaluable, as enabling him to study the arrangement of the different machines required for different kinds of labour, and to make comparative observations respecting them;—a practical school, in fact, which is designed to be permanent—"comeatable," to use a new word, at all times—and presenting, within the compass of an hour or two's walk, and at the expenditure of a trifle, a view of agricultural mechanism which, under other circumstances, would take weeks of travel and much expenditure to obtain. Not that the present collection is so complete as we should like to see it, or as the best interests of the profession demand that it should be, or so well arranged and classified. But to these points we shall hereafter refer, proceeding now to point out the nature and extent of the "collection," and to describe, as briefly as we can, the peculiarities of such novelties as we think will be of interest to our readers.

Our readers will probably have perused descriptions of the Crystal Palace—a building which, whether we consider its extent, the magnificence and beauty of the grounds with which it is surrounded, or the still more magnificent and gorgeous nature of its contents, is certainly without a parallel in the world, and one of which this nation may well be proud. Indeed, we can conceive of no nation—with the exception possibly of the Americans, and as yet they have only talked, not done anything worthy of a name—who could have undertaken, and carried out to such perfection, so grand a scheme. There is something vastly pleasing to an inhabitant of the "tight little island" to wander through its pleasant grounds, or through its glittering aisles, the walls and the roofs of which send flashing back the sun-sparkles, or are anon darkened by the thunder-cloud of our fitful and changing skies—and to note the taste, and to mentally calculate the cost of its gorgeous wonders, and to think that all has been effected by private enterprise aided by private wealth. And at all our visits nothing was more suggestive than to witness the crowds pouring up the broad platform of a railway terminus, and that railway leading solely to and constructed for a private speculation. A private speculation we may call it, but no private exhibition is it. It is well named the "People's Palace." Government wealth and influence may never aid it with the public wealth, but it will be none the less public property. As a national institution, it is difficult to overrate its value—as an educational one, its worth is yet to be appreciated. In point of fact, the public are yet to be

educated to understand how valuable in this respect it will be. As has been truly said, "the newly-awakened man cannot at once be appealed to through the reason, but he may be taught through the eyes. Nature teaches us this in her education of the child. It learns first by seeing, then by reading. Nations have sculptors before they have writers—poets before they have philosophers; because poets draw their images before external nature, and regard it with all the truth, love, and perpetual wonder of children. Chroniclers come before historians, because they record the mere external forms of things, and not the animating soul." It is thus that such an exhibition will in time educate its visitors; nor need those who think that, as an educational experiment, it has been a "dead failure" despair; for the longer it exists, the wider spread will become its influence. It is impossible to tell how deeply the lessons it offers sink into the minds of those who traverse its courts. It is by frequent contact with things of beauty and matters of daily usefulness that the charms of the one and the utility of the other are capable of being estimated and clearly appreciated. The following is the form of the compartment in this vast building, of which we have given but a faint idea, devoted to the reception and exhibition of agricultural machinery. The figures denote the extent and direction of our "walks," into which we divide the department. We prefer to adopt this arrangement, instead of attempting to classify the various implements, inasmuch as it may serve as a guide to those of our readers who may be contemplating a visit to the Palace, and who may wish to refer to any of the machines we have indicated.



Starting from the point 2, and walking down the side 2, 3, the first machine we meet with is Messrs Claytons and Shuttleworth's Portable Grinding-Mill. This is a well-constructed piece of mechanism, exceedingly compact in its arrangement. French burr and Derbyshire greystones are used—the former being indispensable for wheat. The distance between the stones is easily adjusted by a small hand-wheel at the outside of the casing, so as to adapt the mill for grinding a variety of materials.

The next machine we meet with shows us the incongruity arising from a want of correct and scientific classification, and the difficulty, nay almost impossibility, to a visitor who has little time at his command, of making comparative observations and analyses; a point, be it noted,

of as much importance to the practical man as to the student of agriculture. The machine we refer to is the Brick, Tile, and Pipe-making Machine of Messrs Norton and Borie, Brickworks, New Park Street, Southwark Bridge, London. This machine has a high character, and is capable of producing, with proper dies, a variety of hollow or tubular bricks and tiles. The tubular tiles, for which a die is furnished, are well adapted for roofs of barns, &c., where ventilation is desiderated. Each tile is flat, having a series of apertures running in the direction of its length, and provided at its edges with curved joints, which join into each other, and secure a perfectly water-tight joint. When the ends of the apertures in each tile are left closed, the tiles serve admirably to keep the temperature of the apartment low as that of a dairy—the different strata of air remaining in the tubes acting as non-conductors, and preventing the access of heat to the under-side. By the use of a proper die, hollow stairs can be constructed; these will be absolutely fire-proof, and are obviously useful in many agricultural buildings.

We next come to Ashby's Patent Smut Machine, manufactured by W. Coombe & Co., 30 Mark Lane, London. From its compact appearance and high character as an efficient operator, we deem it worthy of a short description. The whole apparatus stands vertically, taking up very little room. The outside case is of strong screen wire, simply clasped externally, so as to be easily removed when worn out. In the interior, a vertical spindle revolves at a high speed, carrying iron beaters the whole length of the case, which revolve close to the inside of wire casing. The base of the machine affords space for a revolving fan, which is keyed on to the lower extremity of the vertical shaft. At the top of the casing is fixed an inverted cone, with an aperture at its lower end: the underside of this is corrugated: parallel to this is another cone, but which revolves at the same speed as the vertical shaft, being keyed thereon. This lower cone is of course in the reverse position to the upper and fixed cone, so that a space is left between them, which can be regulated as desired by a screw. On the wheat being admitted to the interior of the upper cone, it passes through its lower aperture, and by the rapid revolution of the spindle and lower cone it is taken up into the space between the two cones, and is forced up to the highest point, and falls down the wire casing. It then gradually descends, and is rubbed by the revolving beaters againt the wire screen; all the dirt being instantly carried away by the powerful current of air generated by the beaters. The wheat then falls into a vertical spout, to be led away as desired, and as it passes thereto it is met by a powerful blast from the furnace at the base of the machine, which drives all the chaff, &c. into a spout, from which it is conveyed as required. The same firm (Messrs Coombe) also exhibits various samples of their iron wire-cloth, used for flour-dressing machines,

of which they are large manufacturers, and a model of the best construction of which they also show.

The walk 2-3 is terminated by specimens of the Turnip Press Drill, and an Oilcake-bruiser, manufactured by Maynard. The side 3-4 has only one occupant, this being Glover's improved car or chaise back, which is certainly novel in appearance, although possessed of much room, and being safe and of light draught. The front is hollowed out, a seat entering from the front at the side of the horse being on each side of this hollow, while there are seats at the back. A more appropriate place would have been, we think, in the carriage department.

The central space, comprised within what may be termed the "court," 1-2-3-4 (see diagram), is filled with a variety of implements and machines, not very well arranged, of which we note the following: Thrashing machine by Holmes & Son, Prospect Place Works, Norwich; skim cultivator, by Busby, Bedale, Yorkshire; rhomboidal harrows, by Saunders & William, Bedford; Hart's patent Berkshire cultivator; hand-mill and mill-stone by Haxham & Brown of Exeter; improved Barrows by Ellis, of light draught, and not easily overturned; Robert Hunt's hand-seed drill (Earls Colne, near Halstead, Essex); Portable Pump, and a specimen of a Hydraulic Ram. With reference to this machine, we have often been surprised, in our various rambles through our farming districts, that it has not been much more used. Where there is a considerable supply of water, but having little fall, we know of no more economical means of raising the water to any desired elevation (an object of considerable importance in a well-regulated farm-steading, where water at some pressure is so advantageous). To those who may not be acquainted with its mode of operation, the following short description may be useful, and may by others be not considered out of place in our present article. The water to be raised from the low to the high level is led down an inclined pipe, near the foot of which another pipe or chamber branches off at right angles, and which stands vertically. This chamber forms an air-vessel, to the bottom of which a vertical pipe nearly extends. A valve opens upward, leading from the inclined pipe to the interior of the chamber. The farther extremity of the inclined pipe is closed, but near it, and on its upper side, is an opening, which is capable of being closed by a valve, which under ordinary circumstances remains open. As the water flows down the inclined pipe, it issues from the valve opening at its extremity; continuing to run, it quickly acquires sufficient momentum to close the valve, thus preventing the water from flowing out of the pipe. The water, meeting thus with a sudden check, is thrown back, as it were, up the inclined pipe, but meeting with the valve opening into the chamber, it opens this, and passes into the air-vessel. The equilibrium being

thus restored, the lower valve now drops, and the water rushes out as before from the inclined pipe, until it acquires sufficient momentum to close the valve, when the returning water again passes into the air-chamber through the valve. As the water accumulates in the lower part of the air-vessel, the air is condensed in the upper part, and, pressing on the surface of the water, forces it up the vertical pipe in a continuous stream. We may add that the advantages arising from the use of these machines are now becoming more generally known. Messrs Easton & Amos of London have fitted up many, as also Mr Roe, hydraulic engineer, 70 Strand, London.

On the side 4-5 there is not much that calls for special attention. The following are the machines we noted for compact arrangement and good workmanship: J. Cornes' (Barbridge), chaff-cutter; oat, bean, and malt crushing mill; horse-power gear for thrashing-machines, &c.; double cheese-press—all by O. Maggs, near Wincanton, Somerset.

At the corner of the side 5-6, we meet with our first specimen of an agricultural steam-engine, in a compact and well-finished horizontal engine, manufactured by Messrs Turner of Ipswich. In connection with this department of agricultural mechanism, it is gratifying to witness the vast improvements which have been effected, and the wide range of uses to which this powerful adjunct has been applied. It is by no means difficult to remember the time when its introduction as a "farm-assistant" was looked upon as altogether utopian and visionary; now, in almost every farm we find it thrashing the corn, cutting the straw, slicing the turnips, and bruising the corn and the oilcake; and are evidently upon the eve of a new era, when its powers will be still further tested and more widely appreciated—when by its aid the plough will disappear before the steam-cultivator, and the romance of reaping and the delights of haymaking be done away with or greatly modified by its huge labours. "It is upon this power, indeed," says a high authority, "that we must rest our hopes for that mechanical progress of agriculture which our climate and our clays demand, and our mines of coal and iron with equal speciality present the means of." Of the various steam-cultivators which have been tried with more or less success, no model or specimen at the time of our visit was in the Palace. A well-arranged series of models on a moderately large scale would be valuable. Great attention is now being directed to this department of mechanism, but, so far as we know, no description of the plans practically tried has been published, with diagrams showing the arrangements. Mr Fowler's paper at the Society of Arts to some extent supplied this desideratum, but the want of illustrations renders some of the descriptions rather difficult to be understood.

Proceeding with our walk, thus chatting on cognate subjects,

we next notice on side 6-7 an excellent collection of farm-carts manufactured by Messrs Chard & Munro, Bristol—Maynards—Messrs Smith, and Ashby, and Busby. On same side are examples of James's liquid-manure distributor, so arranged that solid matters are prevented from entering the distributor and choking it up. In the centre of the compartment 5-6-7-8 we noticed the following: A wheat tank, or "cilo," manufactured by Messrs Burney & Bellamy, Millwall, Poplar, London. This is of wrought-iron, boiler-plates riveted, with man-hole and registered delivery-spout. Where the grain is in good condition and free from damp, and means taken to prevent it becoming so, there can be no doubt that this method of storing it is infinitely superior to the present unphilosophical method. Besides immunity from the ravages of vermin and of fire, it possesses the further advantage of affording an instantaneous means of registering the quantity of grain stored up. In an article in a former number of this Journal on the preservation of grain, our readers will find the remarks and plans of Mr W. Bridges Adams on this method of storing grain. The same firm manufacture and exhibit excellent water-tanks, constructed in the same way. In this central compartment, Messrs Howard of Bedford exhibit a well-arranged collection of their well-known implements, among which is conspicuous their celebrated "prize plough," so highly praised by Sir William Gibson-Craig, Bart., at the meeting held in Edinburgh last February to discuss the "plough." The Messrs Howards' other implements here exhibited, as the horse-hoe, &c., are so well known that we need not further describe them.

Strolling down the side 8-9, we notice a miscellaneous collection of implements, as "weighing-machines," by Messrs Nicoll & Fowlis, Aldersgate Street, London, for weighing live stock, and adapted for pigs, sheep, and cattle; ingeniously constructed "poultry fountains," by Warren Sharman, Melton-Mowbray, from which a constant supply of clean water is given at several outlets, each of which is so arranged as to prevent dust or dirt from entering; oat-bruisers, oilcake-crushers, and a double-action turnip-cutter, by Messrs Nicoll & Fowlis; a steaming apparatus, by Simpson & Son, Lincoln, very compact; a horse-hoe with rowel-harrow; skim and dray plough, by Busby of Bedale; steam-presser and land-roller, by H. A. Thompson, Lewes, Essex; a variety of crushing and grinding mills, by Messrs Lloyd & Son. On the same side, Stanley of Peterborough exhibits his well-known steaming apparatus; Cambridge's press-wheel roller, to which the "patent scrapers" are attached. Messrs Garrett & Co. exhibit here a few examples of their "drills," "horse-hoe," broad-cast liquid-manure drill, chaff and turnip cutters. The only novelty on this side is the "portable malt-house," patented by A. Fleetwood, Swansea. This is an exceedingly compact arrangement, and

may be briefly described. A circular drum or cage of perforated zinc or galvanised iron revolves on a horizontal axis, and dips into a circular trough containing water. The grain is put into the cage, and allowed to remain in contact with the water as long as necessary. It is capable of being moved to and fro in this by means of "lifts," which are attached to the axle. The whole apparatus is placed within the walls of a furnace or receptacle of brick, iron, or other material, in the bottom of which a fire can be made. When required to be dried, the circular trough in which the water is placed, and which also swings upon centres, is inverted, and when pulled round far enough, forms the top of the machine, an aperture being opened, which forms an outlet or chimney for the vapour, &c. The fire being lighted below, of charcoal or coke, the perforated circular cage is subjected to the action of the ascending current of warm air; and by making the "lifts" revolve, the various portions of the grain can be in turn exposed to the heat. From the small space the apparatus occupies, and the ease of its management, it is well adapted, we think, for the colonies. The arrangement, upon the whole, also, is pretty well calculated to give uniformity of drying, although, in common with all the other machines of this class we have seen, this desideratum is not here fully attained.

The side 9-10 is entirely occupied by an admirable series of full-sized models of "stalls," with all the recently introduced "stable fittings." The first stall we come to is that of Messrs Cottam & Hallen. In this the manger, rack, and water-trough are in one fixture, the interior of the manger and trough being of enamelled ware. To the bottom of the rack a portable seed-box is attached. A patent halter-guide and collar-rein is also supplied by the same makers. The iron stable-guttering and sanitary traps are also worthy of notice. What is called the "sanitary horse pot" is made of iron, and receives the gutter; it is so constructed as to prevent any smell arising, and saves the liquid manure. In the "stall" fitted by Mr James Barton, 370 Oxford Street, London, the general appearance of the fittings closely resembles that of Messrs Cottam & Hallen. The straps and halter-weights are placed at the back of the fitting, to prevent the horse being cast in the stall, and the friction-rollers and bearers are of solid brass, and not so liable to corrosion as iron. Mr Barton exhibits a variety of other appliances — iron gutters, traps, poultry-fountains, pig-troughs, ventilating chimney-caps—of which we believe two hundred have been fixed at Buckingham Palace with marked success. Next to Mr Barton's is the stall fitted up by Messrs S. Hood & Sons, presenting much the same general features as the others we have now noticed. In that fitted up by Mr Bruce, a decided novelty in the hay-rack—which occupies one corner, the other taking up the manger and water-trough—is noticed. In

this the hay is placed upon a movable platform, which moves within an open frame having vertical bars. The top of the frame is made of a grating, through which the hay can be pulled out by the horse. As the hay is consumed, the platform rises towards the grating, against which the hay is kept forcibly pressed by the action of the weight which pulls up the frame. The whole arrangement is novel and compact, and must effect a considerable saving of hay, little being knocked about by the horse while pulling it out. A seed-box can be applied to this rack. The hay-rack is also furnished with an index denoting the quantity of hay it receives. The manger is provided with a simple arrangement, by which a certain quantity of oats is delivered at a time only. It also prevents the horse blowing on them.

On the side 10-11 we meet with examples of Clayton's well-known brick and tile machines. The superior advantages possessed by these machines have long attracted the attention of agriculturists. Mr Evelyn Denison, M.P., stated that a machine which cost him £35, saved him, in his extensive draining operations, £300 the first year. The principal features in Clayton's machine are the "screwing," and the "vertical" principle of moulding the draining tubes or tiles. By "screwing," all extraneous matter is got rid of. The clay, being put in a cylinder open at top and bottom, is brought by the action of the machine upon a plate perforated with small holes; a piston then presses the clay down into the cylinder, forcing it through the holes, leaving stones, roots, &c., on the surface of the plate, from which they are swept off when the empty cylinder is removed, to be replaced by a full one. When, having done duty as a "screwing machine," it is required to form it into a tube-maker, dies are substituted for the perforated plate, through which the clay is forced, in the same way as before, through the screwing-plate. As to the superiority of the vertical over the horizontal plan of making round tubes, there seems, after investigation of the desiderata demanded, little doubt, this holding more particularly when they are of large size. For tiles (horse-shoe, and other forms with a flat side) the horizontal method of manufacture is the best. By a very simple addition to the machine as used for "vertical" work, it can be very speedily adapted to work horizontally.

R. S. B.

(*To be continued.*)

AVERAGE PRICE OF THE DIFFERENT KINDS OF GRAIN,

PER IMPERIAL QUARTER, SOLD AT THE FOLLOWING PLACES.

LONDON.

Date. 1856.	Wheat. s. d.	Barley. s. d.	Oats. s. d.	Rye. s. d.	Pease. s. d.	Beans. s. d.
June 7.	70 4	35 3	23 11	38 0	39 3	40 10
14.	70 8	37 5	23 0	39 0	41 5	42 0
21.	73 5	40 4	23 7	40 0	41 4	39 10
28.	76 5	41 1	26 8	45 6	43 11	41 11
July 5.	79 3	37 10	24 3	46 0	41 2	41 7
12.	81 7	40 0	21 4	47 2	42 7	42 8
19.	82 1	36 4	26 4	46 3	44 11	41 0
26.	79 4	42 0	26 8	44 0	43 4	43 0
Aug. 2.	82 11	40 8	25 6	47 6	43 0	41 8
9.	79 0	42 11	24 7	46 4	48 0	42 8
16.	70 10	42 0	24 8	44 8	44 10	41 4
23.	72 7	45 0	28 2	42 8	39 9	40 5
30.	76 1	47 1	26 10	43 2	40 6	39 4

EDINBURGH.

Date. 1856.	Wheat. s. d.	Barley. s. d.	Oats. s. d.	Pease. s. d.	Beans. s. d.
June 4.	68 3	41 2	29 6	44 0	44 2
11.	73 0	43 0	31 8	47 2	47 9
18.	75 1	43 10	32 10	49 1	49 7
25.	77 8	44 7	33 4	49 4	50 1
July 2.	76 6	43 3	33 8	49 2	50 2
9.	77 10	45 3	34 6	49 10	51 2
16.	80 8	47 10	35 4	51 6	52 7
23.	80 2	47 3	35 7	51 2	52 4
30.	76 7	47 9	34 8	51 8	52 9
Aug. 6.	69 8	48 5	33 2	51 2	52 1
13.	72 1	44 5	34 2	50 0	50 6
20.	73 1	49 9	34 9	50 3	50 10
27.	77 4	45 7	34 8	49 2	49 8

LIVERPOOL.

Date. 1856.	Wheat. s. d.	Barley. s. d.	Oats. s. d.	Rye. s. d.	Pease. s. d.	Beans. s. d.
June 7.	69 4	41 9	22 7	39 6	45 10	45 0
14.	69 0	37 2	23 4	39 11	44 6	43 9
21.	70 2	37 6	24 0	40 6	42 10	40 10
28.	73 9	37 0	23 9	42 4	43 2	44 0
July 5.	73 10	38 9	25 9	43 8	40 8	41 2
12.	71 6	38 6	27 8	44 10	42 1	42 6
19.	75 4	38 2	26 4	45 2	43 6	41 10
26.	76 3	37 11	26 3	44 6	42 4	41 2
Aug. 2.	76 0	39 6	26 10	45 8	41 0	40 6
9.	79 10	40 1	28 0	45 4	44 6	42 2
16.	75 4	40 5	26 3	44 6	42 9	47 0
23.	69 1	45 6	27 3	42 4	40 8	40 6
30.	70 6	45 10	26 3	41 9	40 2	39 8

DUBLIN.

Date. 1856.	Wheat, p. barl. 20 st. s. d.	Barley. p. barl. 16 st. s. d.	Bere, p. barl. 17 st. s. d.	Oats, p. barl. 14 st. s. d.	Flour, p. barl. 9 st. s. d.
June 6.	42 10	18 9	16 1	14 1	25 10
13.	43 2	18 3	15 10	14 3	26 2
20	43 9	18 6	16 2	15 9	26 3
27.	45 3	18 10	16 6	16 4	26 6
July 4.	45 0	19 6	16 10	15 4	26 4
11.	42 7	20 2	17 2	16 0	25 10
18.	45 0	20 6	17 4	16 0	26 8
25.	44 8	22 4	17 1	16 3	26 6
Aug. 1.	42 11	23 6	18 2	16 2	26 4
8.	40 6	22 6	18 0	15 5	25 9
15.	39 0	21 4	17 8	16 0	25 8
22.	38 0	22 2	17 6	15 4	25 6
29.	38 6	21 9	17 2	15 2	25 8

TABLE SHOWING THE WEEKLY AVERAGE PRICE OF GRAIN,

Made up in terms of 7th and 8th Geo. IV., c. 58, and 9th and 10th Vict., c. 22. On and after 1st February 1849, the Duty payable on FOREIGN CORN imported is 1s. per quarter, and on Flour or Meal 4½d. for every cwt.

Date.	Wheat. Weekly Average.	Wheat. Aggregate Average.	Barley. Weekly Average.	Barley. Aggregate Average.	Oats. Weekly Average.	Oats. Aggregate Average.	Rye. Weekly Average.	Rye. Aggregate Average.	Pease. Weekly Average.	Pease. Aggregate Average.	Beans. Weekly Average.	Beans. Aggregate Average.
1856.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
June 7.	67 9	68 0	38 7	39 7	24 3	23 8	42 10	42 9	39 9	39 3	42 8	41 10
14.	68 1	68 3	38 6	39 4	24 3	23 11	47 6	44 3	40 11	39 7	43 5	42 1
21.	69 11	68 8	38 4	39 0	24 7	24 0	44 4	44 4	41 0	40 0	42 9	42 4
28.	72 6	69 3	38 5	38 9	25 9	24 5	48 10	45 7	42 9	40 6	44 0	42 9
July 5.	74 7	70 2	39 7	38 9	26 1	24 9	48 11	45 10	43 0	41 3	44 5	43 3
12.	76 3	71 6	40 2	38 11	24 11	25 0	49 11	47 1	43 7	41 10	45 5	43 9
19.	76 4	72 11	40 4	39 3	26 11	25 5	52 0	48 8	43 9	42 6	46 0	44 4
26.	77 5	74 6	41 8	39 9	27 2	25 11	47 5	48 7	42 2	42 9	45 4	44 8
Aug. 2.	77 10	74 7	42 7	39 11	27 9	26 0	48 4	48 9	43 8	43 0	45 7	44 9
9.	76 0	75 7	43 3	40 9	27 1	26 5	46 4	49 1	42 10	43 3	45 9	45 2
16.	71 0	75 4	43 7	41 7	28 3	26 6	44 3	48 3	39 0	42 8	44 4	45 3
23.	68 9	74 4	44 7	42 5	27 11	26 10	43 8	47 5	38 11	41 11	44 8	45 4
30.	70 8	73 5	45 1	43 3	27 0	27 2	44 1	46 5	39 11	41 4	45 4	45 3

FOREIGN MARKETS.—Per Imperial Quarter, free on board.

Date.	Markets.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1856.		s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
June ..	Danzig	67 6 - 72 6	26 6 - 30 6	16 6 - 23 6	36 6 - 48 0	38 6 - 44 0	36 0 - 42 6
July ..		69 0 - 75 0	27 6 - 32 6	18 6 - 24 0	39 6 - 50 0	38 0 - 45 0	37 6 - 43 0
August		74 6 - 81 0	28 6 - 34 9	19 6 - 26 0	41 6 - 47 6	40 0 - 46 0	39 0 - 45 0
June ..	Hamburg	62 6 - 72 0	26 6 - 36 6	16 6 - 22 6	37 6 - 45 0	41 6 - 50 0	38 6 - 45 0
July ..		66 6 - 75 0	29 6 - 43 6	18 6 - 25 0	38 0 - 46 6	39 6 - 46 0	37 6 - 44 6
August		69 0 - 83 0	32 6 - 46 6	20 6 - 31 0	36 6 - 46 0	37 6 - 45 0	35 6 - 42 0
June ..	Bremen	60 6 - 69 0	29 6 - 36 0	18 6 - 22 0	35 6 - 44 6	37 6 - 43 6	35 6 - 42 0
July ..		64 6 - 71 6	32 6 - 42 0	20 6 - 24 0	36 6 - 51 0	38 6 - 45 0	36 6 - 43 0
August		66 6 - 73 0	35 6 - 44 6	20 9 - 25 0	37 6 - 48 0	39 0 - 46 6	36 0 - 44 0
June ..	Königsberg	64 6 - 75 0	27 6 - 31 6	17 6 - 22 6	34 6 - 45 6	32 6 - 38 6	36 6 - 41 6
July ..		67 6 - 74 6	29 6 - 34 4	18 6 - 25 0	37 6 - 48 0	34 6 - 40 6	37 6 - 43 0
August		68 6 - 76 0	33 6 - 39 6	19 6 - 26 0	33 6 - 42 0	38 0 - 43 6	37 0 - 43 6

Freights from the Baltic, from 3s. 6d. to 5s. 6d.; from the Mediterranean, 6s. 6d. to 10s. 6d.; and by steamer from Hamburg, 4s. to 6s. per imperial qr.

THE REVENUE.—From 30th June 1855 to 30th June 1856.

	Quarters ending June 30.		Increase.	Decrease.	Years ending June 30.		Increase.	Decrease.
	1855.	1856.			1855.	1856.		
	£	£	£	£	£	£	£	£
Customs	5,768,309	5,864,724	96,415	..	22,478,883	23,130,444	651,561	..
Excise	4,763,374	5,005,000	241,626	..	17,642,572	17,552,778	..	89,794
Stamps	1,871,978	1,858,083	..	13,895	7,359,832	7,062,115	..	297,717
Taxes	1,346,031	1,343,026	..	8,005	3,091,875	3,097,026	5,651	..
Post-Office ..	725,000	716,000	..	9,000	2,719,000	2,768,152	49,152	..
Miscellaneous	388,772	317,688	..	8,084	1,175,476	1,432,580	260,104	..
Property Tax	2,259,756	2,376,571	116,995	..	11,665,290	15,187,953	3,522,663	..
Total Income	17,123,220	17,481,272	455,036	38,984	66,132,928	70,231,048	4,489,131	387,511
	Deduct decrease....		38,984		Deduct decrease....		387,511	
	Increase on the qr...		416,052		Increase on the year		4,101,620	

PRICES OF BUTCHER-MEAT.—Per Stone of 14 Pounds.

Date.	LONDON.		LIVERPOOL.		NEWCASTLE.		EDINBURGH.		GLASGOW.	
	Beef.	Mutton.	Beef.	Mutton.	Beef.	Mutton.	Beef.	Mutton.	Beef.	Mutton.
1856.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
June ..	8 9 - 9 6	9 0 - 9 9	7 3 - 8 9	7 6 - 8 9	7 3 - 9 0	7 3 - 8 6	6 6 - 8 6	6 3 - 7 9	6 9 - 8 3	6 9 - 8 0
July ..	8 3 - 9 3	8 6 - 9 6	7 6 - 8 9	7 6 - 8 9	7 6 - 9 0	7 3 - 8 6	6 6 - 8 6	6 3 - 7 6	6 6 - 8 3	6 6 - 8 0
August	8 0 - 9 0	8 3 - 9 3	7 9 - 9 0	7 9 - 9 0	7 6 - 8 6	7 6 - 8 9	6 9 - 8 9	6 9 - 8 3	6 6 - 8 6	6 6 - 8 3

PRICES OF ENGLISH AND SCOTCH WOOL.—Per Stone of 14 Pounds.

ENGLISH.	s. d. s. d.	SCOTCH.	s. d. s. d.
Merino,	16 6 to 24 0	Leicester Hogg,	17 6 to 22 6
.. in grease,	12 6 to 16 6	.. Ewe and Hogg,	15 0 to 20 0
South-Down,	18 6 to 21 0	Cheviot, white,	14 0 to 16 6
Half-Bred,	13 6 to 16 6	.. laid, washed,	10 0 to 13 6
Leicester Hogg,	16 6 to 21 0	.. .. unwashed,	8 6 to 10 6
.. Ewe and Hogg,	14 0 to 18 0	Moor, white,	7 6 to 11 0
Locks,	8 0 to 10 0	.. laid, washed,	5 6 to 7 6
Moor,	6 0 to 7 3	.. .. unwashed,	4 9 to 6 0

EXTRACT FROM JOURNAL OF A TOUR IN AMERICA.

By R. Russell, Kilwhiss.

THE DELTA OF THE MISSISSIPPI.

February 14, 1855.—After nearly four days' sail from Havannah we began to look anxiously for indications of the mouths of the Mississippi, to which we were now approaching; but none were observed until we were within twenty miles of the delta. Before this, discussions had been going on among the passengers, whether the sea still retained its dark-blue colour, or was becoming tinged by the muddy waters of the great river. At last, however, at a long distance ahead, the sea appeared of a light green, and as we drew near this differently coloured water, a very remarkable line of demarcation existed. On one side of the line the water, as in the middle of the Gulf of Mexico, was of a dark blue, and on the other of a light green. This line, stretching from east and west, was so distinct, that you imagined you might step from the one kind of water to the other, and even the waves at the point of junction seemed to be composed of two kinds of water. Both, however, were equally pure; the difference of the colour arose from the water being comparatively shallow on the one side, and very deep on the other. It would seem that the action of the currents of the Gulf have the effect of rolling out the materials brought down by the river into a vast mound around the delta, while the surface-water, at the same time, remains quite pure.

The weather had been wet and stormy, which rendered the voyage very disagreeable, more especially as our steamer, the "Empire City" rolled so much, that no one could walk on deck. Warm south winds were again displaced by a northern, which blew with a clear sky and low temperature as we approached the Mississippi. After sailing for more than an hour, on getting into shallow water, the muddy floods of the Mississippi appeared on the horizon, and imparted a peculiar yellow tinge to the sky. Very soon reeds were seen growing in the low lands of the delta. The muddy water did not extend beyond 6 miles from the land, for the greater part of the sediment is thrown down before it reaches this distance. We entered the south-east pass; and just before doing so, the sea, towards the east and west, was of a dirty cream-colour, and apparently had as much mud suspended in it as our rivers have when in flood. In looking to the south, the crests of the green waves were just visible on the horizon.

The Mississippi, near its mouth, does not strike one with its majesty and grandeur. The channel through which we sailed did not appear to be more than 500 yards in width, and the water on the bar was not more than 18 feet in depth. In consequence of

the shallowness of the water on the bar, navigation can only be carried on by vessels drawing little water, and they frequently strand in the mud through which they are often literally made to plough by the force of as many steam-tugs as may be required for the operation. No vessel of war can ascend the Mississippi, in consequence of the want of water on all the bars of the different channels by which it discharges itself into the Gulf.

It was about the time of high water that we entered, and no sandbanks were visible. Drift timber, however, was seen in immense quantities, lying half exposed where there was little current, and for some miles up the river it literally lined the banks. Reeds are the pioneers of the land plants, and were growing among the water; and for several miles from the mouth nothing but their withered stems was seen. It is seldom that the tide enters the Mississippi, in consequence of its great current of water, but the sea is now and then driven over the surface of the lowest part of the delta when strong winds prevail from the south. This has the effect of preventing the growth of trees, as there are no varieties in the Southern States that are not injured by brackish water. A narrow fringe of willows are the first trees that appear in ascending the river.

We had scarcely entered the channel and got the swamp reeds on both sides of us, before some habitations, erected on piles of wood, were passed. The difficult character of the navigation renders the services of a large number of pilots necessary, who are men of great intelligence, and who are highly paid. The most of them reside at the western pass, or Belize, where there is a population of 500 souls. I was informed that as many as twelve copies of one *American Review* were subscribed for by this small community. To form gardens in this swampy wilderness, earth has been dug from the banks and transported at great expense. Not only is the swamp inhabited by those engaged in the navigation of the river, but settlers have taken possession of the extremity of the delta. Considerable numbers of cattle were browsing among the reeds, and at intervals the cottages of their owners formed specks in the dreary landscape.

The manner in which the formation of the delta takes place, requires to be borne in mind to obtain a clear view of the physical peculiarities of Louisiana. Before the Mississippi was settled by Europeans, it overflowed its banks every year for more than 1000 miles from its mouth. Its banks were then covered by a dense forest and a thick undergrowth of shrubs. The land is considerably higher along the margins of the river than it is at a short distance from them, for the muddy water was deprived of its sediment as soon as it overflowed the banks and filtered towards the interior. An annual layer of alluvial soil was thus added to the banks, which are raised above the general level. The filtered

water that reached the interior swamp found its way to the sea by a channel of its own. This action of the river is still seen in the lower delta, where it is not protected by embankments.

By glancing at the sketch, it is observed that the delta terminates in a narrow tongue of land which leads out the Mississippi far into the Gulf of Mexico. On entering one of the channels, and sailing a short way up the river, the sea is observed on both sides, and we become sensible that the river is considerably above the level of the sea. During the time that the Mississippi is in flood, the lower part of its delta, where there are no embankments, is converted into a vast mouth. A thin sheet of water finds its way to the sea through the reeds and coarse grasses, which, as already observed, arrest the earthy matter and raise the borders of the river.

Near the mouths of the different channels of the Mississippi it is very obvious that there can be little difference in the height of the river at the high and at the low season; because the proximity of the Gulf prevents any accumulation of water taking place. The difference betwixt high and low water increases as we ascend the river. It was the low season when I sailed up to New Orleans, and the mud-bank at Fort Jackson, thirty miles from the mouth, appeared to be only about 2 feet in height, and, of course, as soon as the water rose above this height, it flowed directly towards the sea, across the neck of land. At New Orleans, 110 miles from the mouth, the difference betwixt high and low water is 10 feet; at Natchez, 30 feet; and at the junction of the Ohio, 50 feet.

The delta of the Mississippi is two hundred miles in length, and averages about seventy-five in breadth, and its estimated area is fifteen thousand square miles. A very small portion of this extent is capable of being cultivated; for the interior is a vast swamp covered with trees, whose tops only are sometimes visible during the flood season. The Mississippi sends several channels, called "Bayous," through its delta in more direct courses to the sea than the one it pursues itself. Many of these contain little water except during flood. The banks of these subsidiary channels are also higher than the interior, and they have been formed by the overflowing of the sedimentary waters in a similar manner to those of the main stream. The cultivated land of the delta is entirely confined to the banks of the river and those of its bayous, and rarely extends beyond a mile from the channels. And these margins along the river have only been reclaimed by the formation of embankments, or "levées," to prevent inundations.

The physics of the Mississippi has formed the subject of considerable discussion among American engineers, and some curious results have been elicited. In the first place, it is necessary to observe, that although the river is only 600 yards in breadth

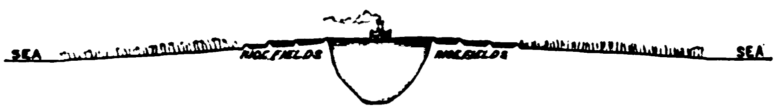
at New Orleans, it is considerably more than 100 feet in depth. The bed of the river at New Orleans is thus more than 100 feet below the level of the sea; and as the water on the bar is scarcely 20 feet in depth, the water in the *bed* of the river seems to flow up-hill towards the sea. It is a peculiarity of most of the large rivers in the Southern States, that they scour out for themselves very deep channels towards their mouths. The greater part of the river is now embanked as far up as St Louis, a distance of 1300 miles. Before it was so, the floods converted the delta into a vast lake; but since the formation of the embankments, which prevent the water from flowing into the swamp, it has been found that the river does not rise much higher in its lower course than it did before the extension of the levées. This is a result which was not looked for by engineers; for it was expected that the levées would require to be raised so much higher below in proportion as they were extended up the river. The greater body of the water being kept within these levées during floods has increased its motion, and given it greater powers of forming for itself a deeper channel, which has had the effect of rendering the same height of levée sufficient to prevent inundation in the lower parts, as was sufficient before the Mississippi was kept so much within its banks above. The bayous have also had their channel enlarged by their banks being protected by levées, and they also carry an increased quantity of water to the sea during floods.

Before reaching Fort Jackson, a belt of trees, perhaps 100 yards in breadth, occupied both banks along the river. They consisted of willows, elms, alders, and fan palms, which last were from 6 to 10 feet in height. Several full-sized and beautiful orange-trees, heavily laden with fruit, were growing within the ramparts of Fort Jackson. After passing the Fort, the river is embanked on both sides, and the land is chiefly in the possession of small proprietors. There are a good many orange-groves along the river: the fruit was all gathered, but the dark-coloured evergreen leaves relieved the wintry aspect of the scenery. The trees in the swamps are all deciduous, with the exception of a few live oaks; and the willow alone was putting forth its light green leaves.

For thirty miles above Fort Jackson, small rice-plantations are very common on both banks. And it is worthy of observation, that these settlements are comparatively healthy for white persons, who in many cases cultivated the crop with their own hands. The cultivation of the rice-crop is effected by a very different process from that which is followed in the tidal swamps of Carolina.

The Mississippi usually begins to swell in the delta about the end of February, and continues to rise till the 1st of June, from which time it again gradually subsides. It is thus in flood during the hot season. A ditch, having a sluice on its mouth, is dug

from the river towards the swamp. The land immediately behind the levée being the highest, is cropped with Indian corn and potatoes. But at a little distance from the river, where the land is lower, and can be flooded, it is laid out in narrow rice-fields parallel to the river, somewhat in the manner indicated in the sketch.



These narrow strips of land are banked all round, so that they can be laid under water after the rice is sown. The land is ploughed in March, and shortly afterwards it is sown and harrowed. As soon as the young plants appear above ground, the water is admitted from the river, for the purpose of keeping the weeds in check. The crops grow rapidly, and the depth of the water is gradually increased, so as to keep the tops of the plants just above it. There is a constant current of water flowing from the river into the fields and over the swamp, so that there is no stagnation, and the fields are not laid dry till the crop is ready to cut. The only labour that is bestowed in the culture of the crop is to pull up by hand the weeds, which are mostly grasses; and this operation is effected by men going into the fields knee-deep in water. The produce varies from 30 to 60 bushels of rice in the husk; it is separated from the straw by the treading of horses. The quality of the Louisiana rice grown on these small farms is inferior to the Carolina, as much less skilful management is bestowed upon its culture.

These small properties under rice-culture furnish some important features in connection with the labour question; for this cluster of white settlers on the lower delta of the Mississippi, indicates that it is not so much the mere feeling of the degradation of free labour that prevents the whites being more engaged in agricultural operations, but rather that the culture of sugar does not afford a field for them. Two causes, perhaps, conspire to produce this result: first, the more unhealthy nature of the sugar-fields; and, second, free labour cannot compete with the organisation of slave labour in the manufacture of sugar. At the present time, however, there is rather a tendency for these small rice-plantations being absorbed into sugar-plantations, and cultivated by slave labour.

Notwithstanding the swampy nature of the country at the mouth of the Mississippi, as already observed, it is more healthy to the white inhabitants than any other part of the delta. The small rice-plantations, even in the lower parts of the river, are more salu-

brious than the sugar and cotton plantations which are under dry culture. Indeed, in hot countries, it seems to be the universal experience that the cleaning and cultivating of rich alluvial lands render these countries more unhealthy than they were when covered with the natural vegetation. The swamps of the Mississippi, Savannah, and all the other southern rivers, as well as the interior swamps, such as in the Carolinas,* were not unhealthy in their natural state; they have only become so since they were brought under cultivation.

The most satisfactory theory of malaria, is that which has been proposed by Liebig in his brilliant chapters on *putrefaction, fermentation, and decay*. The miasmata, which produce the various endemic diseases, are ingeniously supposed to exert their virulent influence on the human body, by entering the system as gases, and acting on its fluids as a species of ferment. The decomposition of animal and vegetable substances assumes, under certain conditions, very different characters, and gives rise to very different products, which may or may not have a prejudicial influence on the system. It has been generally taken for granted, that marshy grounds are necessarily more unhealthy than dry, and it has been forgotten that numerous exceptions to the rule are found in all countries. The exceptions, however, appear to be all connected by one principle.

Some years ago, I pointed out that it was a well-understood fact in Scotland, when some of its inhabitants were very subject to ague, that wet clay soils produced that disease, while wet peaty soils did not. The character of the decomposition of the vegetable matter taking place on clay and on peaty soils being different, the emanations which arise from the former seem to have a deleterious influence on the human system, while the latter are quite innocuous. Indeed, our peat-mosses in Scotland have decided antiseptic properties, which no doubt serve to retard decomposition, and the products of decay are quite peculiar. Among these peculiar products, the vegetable extract that imparts the dark-brown colour to many of our Highland rivers is well known. Now, it is rather curious that all the swampy districts which are healthy in the Southern States are characterised by the water being coloured by this vegetable extract. In the Great Dismal Swamp of Carolina, Sir Charles Lyell says, "the water is transparent, though tinged, by a pale brown colour, like that of our peat-mosses."† It appears

* It is to be remarked that the climate, in the interior of the swamps, is far from being unhealthy. Lumber-men who spend great portions of the year in it, cutting shingles and staves, testify to the general salubrity of the air and water. The opinion prevails among them, that the quantity of *pine* (?) and other resinous trees that grow there, impart a balsamic property to the water, and impregnate the air with a healthy resinous fragrance, which causes it to be an exception to the usual rule of the unhealthiness of swampy land.—*Dred, a Tale of the Great Dismal Swamp*. By Mrs Stowe.

† Lyell's *Travels in North America*, vol. i. p. 147.

that all the water in the swamps of the Southern States is of the same character, and it is very probable that the fact of its being so is indicative of the vegetable accumulations from which it proceeds undergoing that species of decay which is not an unhealthy one.

Dr Hooker, in his *Himalayan Journals*, writes: "The climate of Chattuc is excessively damp and hot throughout the year, but though sunk amid interminable swamps, the place is perfectly healthy. Such, indeed, is the character of the climate throughout the Jheels, where fevers and agues are rare; and though no situations can appear more malarious to the common observer than Silhet and Cachar, they are in fact eminently salubrious. These facts admit of no explanation in the present state of our knowledge of endemic diseases. Much may be attributed to the amount and *purity* (?) of the water, the equability of the climate, the absence of forests, and of sudden changes from wet to dry; but such facts afford no satisfactory explanation. The *water, as I have above said, is of a rich chestnut-brown in the narrow creeks of the Jheels*, and is golden-yellow by transmitted light, owing, no doubt, as in bog water, and that of dunghills, to a vegetable extract, and probably the presence of carbonetted hydrogen."

The climate of the southern states of America is in every way the opposite of that of the Jheels, for it is anything but equable; forests abound, and the changes from wet to dry are great and sudden. The only conditions that seem to be common to the healthy swamps of America and of India are large *accumulations* of vegetable matter, resembling our peat-mosses, and the presence of this brown-coloured water. Modern geologists have been too hasty in assuming, that the high temperature of the summers on the borders of the tropics is sufficient to prevent the accumulation of vegetable matter, such as is the case in higher latitudes where the natural vegetation in moist situations of one year does not rot away during the next. Sir C. Lyell supposes the shade of trees is essential to the accumulation of vegetable matter in so low a latitude, 34°, as that of the Dismal Swamp, where there is a deposit of peat from 10 to 15 feet in thickness. But according to Dr Hooker, accumulation takes place in the Jheels, which are on the borders of, and even within the tropics, where there are no trees. In another part of his "Journals" he writes: "The soil, which is sandy along the Burrampooter, is more muddy and clayey in the centre of the Jheels, with immense spongy accumulations of vegetable matter in the marshes, through which we poked the boat-staves without finding bottom; they were for the most part formed of decomposed grass-roots, with occasionally leaves, but no quantity of moss or woody plants." In fact, it appears that these accumulations of vegetable matter which impart the peculiar tinge to the water in the Jheels, have as close a resemblance to our peat-mosses as the different climatic conditions admit of. The decaying

process is arrested in both cases, and hence it is probable that this circumstance is the cause of the Jheels, as well as swamps of the Southern States in their natural condition, like our peaty districts, being comparatively healthy.

But the cultivation of damp soil, by which it is exposed to the atmospheric influences of a hot climate, invariably gives rise to malaria. Even the first effect of draining marshy grounds is to render them less salubrious than they were in their natural state. For this reason the Campagna in Italy became much more unhealthy, as Dr Arnold states in his *Roman History*, after its drainage. As already observed, the sugar and cotton plantations in the bottom lands of the Mississippi, are less healthy than the undrained swampy lands in lower parts of the delta. The malaria of the rice-fields of Italy, and of the tidal swamp of Carolina, is of a very deadly character. The practice adopted in these parts of laying the fields dry at intervals during summer and autumn, and exposing them in a moist state to the sun, seems to favour the production of deleterious exhalations. But as Captain Smith, when referring to the experience of India, very properly contends, in his excellent work on Italian Irrigation, there is nothing deleterious in the mere culture of rice, but in the mode in which the irrigation is managed. Where there is no stagnation of water the rice-fields are not unhealthy. This opinion, I may here remark, is confirmed by the fact that the rice-grounds at the mouth of the Mississippi, on which the water is not allowed to stagnate, are more healthy to the whites than the sugar and cotton plantations on the rich alluvial lands.

As we sailed up the river the air was cold, and at night became quite frosty. Next morning, when we landed at New Orleans, the hoar-frost was lying white on the wharves. During the day, however, the sun shone out with great brilliancy, and the temperature was pleasant and bracing. The wintry aspect of vegetation in the swamps of the Mississippi, and the dingy houses of the Crescent city, do not impress one at this season very favourably, after having left so lately gay Havannah and its lovely neighbourhood. The wharf extends for two miles along the eastern bank, and the immense area that is covered with cotton bales exhibits the enormous interests connected with the staple produce of the South. A fleet of steamers painted white, and having double funnels, line the landing. It is estimated that there are now 1500 steamers on the Mississippi and its tributaries.

The cotton crop begins to arrive at New Orleans in the early part of August. The business season then commences, and from 20,000 to 30,000 white labourers are attracted from the Northern States by high rates of wages. The cotton continues to arrive at the city till the beginning of summer, when the fluctuating population again return to the North, where the climate is more salu-

brious. Yellow fever makes its appearance almost every summer at New Orleans, and commits great ravages among those who are not natives of Louisiana. The last severe visitation of this pestilence occurred in 1853. According to Dr Bennet Dowler, the population of the city was 150,000 when the epidemic broke out in June, but 30,000 fled to the country, and up to the 1st of November the aggregate mortality from yellow fever was 8451 deaths. At no former period did the malady spread so much over the country as in that year; for all the small towns in Louisiana and Mississippi suffered. If cleanliness would assist in mitigating the ravages of this fearful pestilence, as it certainly does in other epidemics, the city authorities are blamable for the filthy state of the streets. The sewers are open, and the putrid exhalations are very offensive even at this cold season: this state of things is the more inexcusable, as an abundant supply of pure water might be easily raised from the Mississippi, even when the river is low, to sweep the filth of the streets towards the swamp.

I put up at the St Charles Hotel, one of the finest establishments in the United States. About one thousand visitors can be accommodated; but I found all the rooms engaged when I arrived in the morning. A large number of departures soon put me in possession of a good bedroom. The bells are all rung by electricity; by slightly pressing a small knob with the thumb, the number of the bedroom is made known in the office below. The most of the waiters are Irish, and no coloured servants are employed. Considerable difficulties are found to arise in hiring in so many slaves, and it would require too large a capital for the hotel proprietors to own them. White servants are therefore employed in the large establishments in the south. The chambermaids are also nearly all Irish, and I was assured that they are singularly trustworthy and virtuous in the midst of the many temptations to which they are exposed.

To-day, by a rather curious coincidence, I met a gentleman very unexpectedly about whom I had formerly made inquiries. When at Charleston I was interested with some essays on Southern agriculture that appeared in the newspapers, but could not then learn anything of the designation of their author. I had taken down his name in my note-book with the intention of inquiring after him when I got to the South-western States, for his writings reminded me more of Cato's than any that I ever read. One can therefore imagine my surprise when a few minutes' conversation with the stranger on my right hand at the breakfast-table, the first morning that I landed from Havannah, made me aware he was the gentleman I was so anxious to see. The making of his acquaintance was quite a hit; he was a Scotchman, and had been in the country for upwards of twenty years. Among all the parties to whom I had introductions in the United States, on

none, somehow or other, did I consider I had so great a claim for attention as upon the one whom I had thus luckily fallen in with. He resided in the neighbourhood of Natchez, where I had introductions to some large planters who happened to be from home, so I afterwards gladly availed myself of my countryman's hospitality.

The New Orleans newspapers contained advertisements almost every day of sales of slaves to take place in town or country. I devoted one forenoon to see if there were anything doing in this business. No slaves were advertised to be sold in town in the morning papers of that day; but, on going into the rotunda of the St Louis hotel, I saw a group of about twenty slaves—men, women, and children—seated on a low bench in front of the stall of an auctioneer, who was then selling some town property. While the sale was going on I walked about in the elegant building, which also serves as a bar-room to the hotel. It is perfectly circular within; and its domed roof, 60 feet in height, beautifully painted, is supported by Corinthian columns around the sides, where auctioneers' stalls are raised about four feet from the ground. The bar, having a fine marble counter, occupies about one-third of the side-space. The transition from selling one kind of property to the other was sudden. The first slave sold was put up for sale standing on the platform beside the auctioneer, and the bidding soon went on very rapidly among a crowd of about a hundred persons. This slave was a stout young mulatto, so well dressed, and with so little of the appearance of a slave about him, that I was looking for the object of this active competition among those who sate below. He was at length knocked down at 1300 dollars (£265), after which he stepped off the platform. The next put up was a young woman, whose qualifications were well rehearsed as being a good cook, could speak French and English: she sold for 1130 dollars. Two other household servants at 900 each, one of whom could speak English, French, and German. A man and wife, who were put up as field-hands, brought 1900 dollars. An old woman sold at 340 dollars. She was the only slave who appeared to be much concerned about this strange scene, for she began to weep when the bidding slackened. The rest of the slaves were not sold, as the prices were deemed too low. However, the auctioneer, a Frenchman, did his part with great energy. He spoke alternately in French and English. Often would he seize the "boys" by the arm and maintain that "such strong chunky field-hands" were going far below their value. Among the slaves gathered together for sale was a fair mulatto boy, about seven or eight years of age, neatly dressed in green pants, brown surtout, and white hat, with a band of crape around it. Altogether he seemed

quite a little gentleman, and as he romped about during the sale he appeared quite happy amid all that was going on. His mother and the other slaves who were not sold were ordered to go away to the "office" of the auctioneer, and the little fellow danced around her as merrily as if he had been at school.

February 17, 1855.—I left New Orleans to-night in one of the first-class steamers for Natchez. There were 120 passengers on board, but this number made no appearance of crowding in the large saloon, which extended nearly the whole length of the vessel. The berths were large and airy, and an amount of comfort was afforded that we never look for in a steamer at home. The sumptuous and prodigal repasts which were laid out at the different meals were quite astonishing. The most of the Southerners with whom I came in contact were polite and well-informed; and among this class the use of tobacco or spirits is not nearly so prevalent as is commonly believed.

The scenery on the lower Mississippi is very poor, especially in winter, when vegetation is almost as dead as it is at the same season in our own northern climate. There is exceedingly little variety in the aspect of the country. The forest is mostly all cut down along the banks of the river; while tall trees, having an immense quantity of moss, of a dull-grey colour, hanging from every branch, occupy the swamps in the background. The cultivated land along the margins of the river varies from half a-mile to a mile in breadth. The water being still low, the steep mud-banks gradually became higher as we ascended the stream; but we obtained almost a bird's-eye view of the country by going up into the look-out house of the steamer, which was 60 feet above the surface of the water.

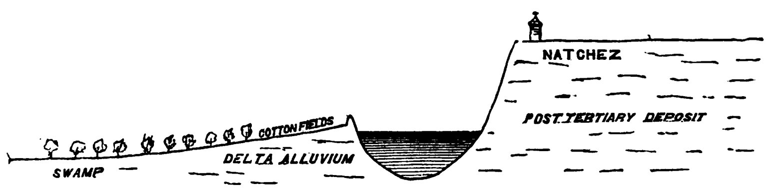
The plantations are almost exclusively devoted to the culture of sugar-cane as far up as the 31st degree of latitude. After this cotton plantations begin to take the place of sugar, and in their turn occupy both sides of the river as far as the northern parts of Tennessee.

On the evening of the following day after leaving New Orleans, we reached Natchez, a distance of 284 miles by water. This was accomplished in 24 hours, though a number of stoppages were made to take on board or land goods and passengers. The driving-wheels were 44 feet in diameter, and propelled by two high-pressure engines, reckoned at 850 horse-power each. A speed of 17 miles an hour against the current was sometimes attained.

Above New Orleans I saw no wharves at any of the small towns on the river, as the soft mud-banks almost everywhere afford facilities for the steamers landing. The produce of the plantations on the river is therefore shipped from the levées—a circumstance which is of great importance, as all land-carriage is dispensed with.

It was dark when we reached Natchez, and a considerable quantity of rain had just fallen, which rendered the mud-banks very slippery—so much so, that it was with the utmost difficulty that I scrambled up to the conveyance that was waiting to take passengers to the hotel.

At Natchez the features of the country are much changed. At Baton Rouge, 129 miles above New Orleans, the east or left bank of the river is about 25 feet higher than the recent alluvial deposit, and belongs to a different geological formation. This formation consists of a compact silicious clay, containing fresh-water shells of the same species as those which are still living. The raised land at Baton Rouge is the first appearance on the Mississippi of the vast plain or table-land that stretches towards the Lakes, with an easy ascent of less on an average than one foot to a mile. At Natchez this formation rises about 250 feet above the river, and forms, from being undermined by the river, a precipitous bank of that height, while the west bank is low, and the plantations are protected by levées. The figure will show this more clearly.



The top of the high bluff or bank at Natchez commands a view of the windings of the Mississippi, which is soon lost amid the immense cedar-swamp that stretches towards the west. Here the river appeared narrower than at any other place I had seen it. Its breadth did not seem to be more than 500 yards, but its depth is considerably above 100 feet, and the current is rapid.

The high table-land forming the precipitous bank at Natchez is broken in the vicinity of the river, as in other northern States, into a series of rounded eminences, by the action of the streams from the interior of the State. The face of the country, from this cause, is somewhat irregular in the neighbourhood of Natchez, but it soon becomes less so a few miles inland.

Natchez is the capital and principal city of the State of Mississippi, but it does not contain a population of more than 6000 souls. The houses are mostly built of red brick, and the streets are wide and planted with trees along the side-walks. Numerous fine villas are seen in the suburbs, and some of them have flower-gardens with statuary. I believe there is as refined society to be found in Natchez as in any other part of the United States. The American system of slavery is by no means favourable, however,

to the growth of the inland towns. In fact, the poorer part of the white population in such towns as Natchez, and Baton Rouge in the South, are placed in anything but a favourable position. Numbers of idlers are to be met with in all these towns. The chief frequenters of the best hotel in Natchez were low drunken fellows; and though the accommodation was very middling, the charges were as high as at the St Nicholas in New York.

The overseers of the plantations are selected from the lower grade of whites, and they are looked down upon by the best society of the South. An overseer has often a large amount of power delegated to him. I was told that some successful planters who hold several estates in this neighbourhood, make it a rule to change their overseers every year, on the principle that two years' service is sure to spoil him. This necessity must no doubt aggravate the condition of the slave, for it is very generally allowed that the negroes are much better cared for under the eye of a master than of an overseer, especially when the connection of the latter is in general so temporary. The cultivation of cotton and its preparation for market are comparatively simple processes, and capitalists find a profitable investment in cotton estates, even when they are managed by overseers. But it is found more difficult to manage a sugar-plantation in the Southern States, and for this reason,—a sugar-plantation can seldom be profitable, unless the planter resides upon it and superintends it himself.

The same formation that is found in the bluffs at Natchez extends for upwards of twelve miles to the east of the Mississippi, and the surface-soil over this region is one of the finest for the growth of upland cotton in the Southern States. It is upwards of one hundred and fifty miles from north to south, and was originally covered by a magnificent forest of hard-wood. The soil is naturally very fertile, consisting of a friable vegetable mould, from a foot to a foot and a-half in depth. Indeed, it is one of the richest and most easily cultivated soils that I ever saw.

Rich as these upland soils are when first broken up, they are subjected to certain deteriorating agencies which we hardly know anything of at home. This does not arise merely from the exhausting system of culture that is followed, but also from other circumstances. As was formerly mentioned, the subsoil is a compact sandy clay, which does not crack with drought, and is little pervious to air or water, and for this reason, perhaps, it is not genial to vegetation. Now it must be remembered that the most of the rain in this region falls in heavy thunder-showers; indeed, from three to four inches of rain sometimes fall in one prolonged thunderstorm. The beautiful surface-soil is rendered loose and free by cultivation, and these deluges of rain surcharge it with water which cannot descend into the subsoil. At length the

water bursts in torrents down the slopes, and carries large quantities of the earth with it into the streams, and thence to the Mississippi. Thus the land would suffer more waste under fallow than under crop, for vegetation assists in checking the destruction. From Natchez to Washington, a distance of six miles due eastward, the most of the country is irregular, and all the sloping land is ruined, for the fine soil has been as completely carried away by washing, as if it had been dissolved. Little remained but the subsoil, which is almost as unproductive as the pine-barrens of Carolina.

Almost everywhere in America the quality of the soil is indicated by the kinds of trees which grow upon it. The first settlers found these uplands covered with a magnificent forest, consisting of liquid-amber, elm, ash, white and red oak, cherry, magnolia, mulberry, and the wild grape, as well as now and then a solitary pine. The greater part of this fine forest is cleared away, and the land is now under cotton cultivation, or abandoned as exhausted. Here and there, however, a patch of the original forest is to be seen to attest its former grandeur. When the land is first cleared, and the brushwood burned, the stumps are allowed to stand until they moulder by natural decay. By the slightest scratching with the plough, this virgin soil has in many instances been taxed with from fifteen to twenty crops of Indian-corn or cotton in succession.

Not only is the exhaustion of these soils exhibited in the inability of the land to produce cotton or Indian-corn, but the oak, the magnolia, and the other broad-leaved trees that flourish on these soils in their natural state, no longer find those conditions which are favourable to their growth. It is a curious fact, that if the primeval forest is cut down, and the soil is not wasted by washing or cropping, the same trees will again spring up and occupy the ground. But it is still more curious, that totally different trees make their appearance in all cases in which the land has been exhausted by tillage, and afterwards abandoned to nature. In the latter case the pine and crab-oak alone occupy the ground. These facts are directly opposed to Decandolle's theory of rotation of crops. The substitution of the pine for the oak and magnolia in the exhausted soils of the Natchez uplands is evidently owing to the altered physical condition of the soil.

Horticultural experience favours this view of the matter. Fruit-trees do not thrive well on those exhausted soils, and this cannot be ascribed to mere sterility, for the apple-tree flourishes and produces abundance of fruit on the granitic gravels of New England, which would certainly be too poor for cotton, though the climate there had been as favourable as in Mississippi State. It is probable that the ungenial nature of the subsoil, arising from its close and compact nature, cannot maintain the magnolia and

peach in healthy growth, both of which must send their roots into a medium capable of supplying them with sufficient moisture during the torrid heat of summer. I was informed that neither the peach nor any other fruit-tree would thrive on the exhausted soils, however well they were manured, unless the ground was cultivated by the plough or the spade. If the cultivation is neglected, many of the leaves drop off during dry weather; and in no long time after the rains again set in, the fruit becomes quite dropsical, and falls off too. The same kinds of fruit-trees do well on unexhausted ground without any cultivation or manure. These facts all point to the view that I have already expressed—that in these instances it is the physical condition of the soils which determines the particular kinds of trees that flourish on exhausted and on unexhausted soils. The pine, it is probable, evaporates less water than the broad-leaved trees, and it can therefore thrive in dry sandy soils, where other trees cannot. Sir Humphry Davy, I think, says in some of his lectures on agricultural chemistry, that plants with glossy leaves do not evaporate so much water as others. Is it because the thick glossy leaves of the live oak evaporate little moisture that we find this the only hard-wood tree that grows, beside the long-leaved pine, on the dry sands of the pine-barrens?

MECHANICAL AIDS TO STEAM CULTURE.

By ROBERT SCOTT BURN, Author of "Land Drainage: its Projects and Prospects," &c. &c.

AGRICULTURISTS live in stirring times. No sooner is their attention directed to one innovation, and through the effects of successful practice they are brought to confess that "there is something in it," than another is presented to them of a still more startling character, drawing more copiously than before on their powers of credence; giving a more painful shock to the prejudices of the "slow," and a more decided impetus to the progressive faculty of the go-ahead farmer. A few years ago, through a variety of causes, an impetus was given to the question of machine-reaping, which has had, and still has, a potent effect in bringing this desideratum in field-practice nearer to perfection. And now that the aid of our machinists and practical agriculturists has brought it to a point which, despite a few mechanical difficulties—these in process of time being doubtless fully overcome—renders it entitled to be reckoned as a thing accomplished, thinking men are painfully pondering over a problem possessing still greater difficulties, but yet holding out a more splendid prize, than that to which we have just alluded. This great problem is "steam culture." In

full view of the wondrous aid which the power of steam has afforded us in our mills, on our railways, and alike on the placid lake or restless ocean, not to note the little which it has given to us on our farms—though that little is very good—we can have no difficulty in believing that in this latter department it is capable of performing great things. Steam has as yet done but little for our soil; we have only witnessed the playful gropings and graspings, as it were, of its infant strength, suggestive doubtless of the mighty labours of its riper years, which are destined yet to astonish and delight us. And much as agriculturists owe to our mechanics and engineers, the time is not so far distant when they will receive from them a richer boon, and owe them a deeper debt of gratitude. The triumphs of the cotton-factory or of the railway are yet to be transferred to our fields, and the genius which has clothed has yet to aid in feeding the teeming millions of the earth. The "ploughboy's whistle" is destined now and then to be drowned in the shriller notes of that of the "steam horse," and the ploughman's toil lessened by its untiring labour, while its smoke is wafted "over the green fields celebrated by Thomson."

Taking into consideration the revolution in farm management which the introduction of steam culture must necessarily bring about, and the economical results derivable therefrom, it is impossible to over-estimate the importance of the subject. In fact, it is second to none of all the great questions now agitating the agricultural world. How it is to be effected—whether by the retention of the present implements more or less modified, or by the introduction of a principle of action altogether new—remains to be seen. The problem is a great one, and the difficulties surrounding its solution are of no ordinary kind; but the prize in view of it is worthy of almost any amount of human labour, and the patient exercise of human ingenuity. The future of agriculture may be said to depend upon the solution of the problem; for a large class —and that a most productive one—of soils may be said to be already worked up to as high a pitch as the present mechanism applied to them will admit of; and the farmer who has wisely used them is now waiting for the genius of mechanism still further to aid him, and to enable him to command and control his circumstances. This alone can sleepless energy, with the mighty power of the steam-engine, give him.

To note, then, what has been already done—what men have been, and what they are now, thinking about such an important matter—and in what direction further progress is likely to be made—cannot fail to be of high interest to our readers.

In presenting our "notes" on these points, we purpose to follow an arrangement somewhat as follows: 1st, A notice of the endeavours of early inventors, leading to a classification of the different methods proposed up to the present time; 2d, Descriptions

of the most important projects under the different "classes" so decided upon; and, lastly, An inquiry into the principles which regulate the cultivation of the soil, deducing therefrom what seems likely to be the *philosophical direction* in which the aid of mechanism will be sought.

The subject admits of a profusion of illustration—so much so, that a goodly-sized volume might be devoted to this alone; we have, therefore, seeing the difficulty of selection, endeavoured to avoid, as far as possible, the use of illustration, trusting that the fulness of the description, with the aid of what may be called tables of "movements," will in some measure compensate for their want. In some instances it has been found essential to add simple diagrams, illustrative of parts of which no description, save a very lengthy one, could afford a clear idea.

In our paper on reaping-machines (Nos. 47, 48, p. 611) in a former number of this Journal, we drew attention to the fact that, although to many the notion of such an aid in farming was perfectly new at the date of the Great Exhibition of 1851, an event which may be said to have been the main exciting cause of attracting attention in this direction—nevertheless, it was one which had for a long time occupied the attention, and been partially carried out through the exertions of many machinists. The same remark applies to the subject of our present paper, for more than two hundred years have elapsed since the first record was made of an attempt to substitute some other power for that of horses in the cultivation of our soils. Properly speaking, the patent of David Ramsay in 1630, with its title "Making the Earth more Fertile," was more a record of an idea that such a power might be substituted, than any real attempt to carry the idea out. Indeed, the same remark applies to a large proportion of the patented machines in this department. Ramsay's "idea" seems to have been that the power of the steam-engine, then known as the "fire-engine," might be applicable to the propulsion of carriages over the land, and through them to the cultivating instruments then in use. Between the date of this patent and the next we find recorded, a long interval of one hundred and thirty-seven years occurs. In 1767, Francis Moore patented a "fire-engine to supplant horses," &c., not only for the cultivation of the land, but the dragging of carriages, &c. "Time out of mind" it has been the distinguishing peculiarity of the schemer and inventor to have bright day-dreams of great success, and Mr Francis Moore seems to have been no exception to the general rule; for tradition tells us that so confident were he and his friends (an inventor's friends! —lucky man, luckier than inventors nowadays), "that horses were doomed, and about to be superseded by steam as a motive power, that they sold their teams in order to avoid the loss, convinced that they (horses) would soon be reduced to one-fourth their

value." Inventors have a happy knack of comforting themselves with the thought that their inventions are to revolutionise practice and supersede all others. It is as well that this should be so, for with the difficulties which in time beset them, and the losses they encounter if they determine to persevere, it is the only comfort that many of them are ever destined to realise.

The next recorded patent is that of Richard Lovell Edgeworth in 1770—which may be taken as the forerunner of the plans of "endless railways," of which category of inventions "Boydell's traction-engine" is a very notable example, and of which we purpose giving full details in the course of our paper.

In 1784 the celebrated James Watt took out a patent for "steam-carriages," "the propulsion of land-carriages." This did not go further than a mere notice, as the patentee conceived that the boilers would not stand the high pressure necessary.

In 1810, Major Pratt took out a patent comprising several important claims. Of this Mr Burness gives the following description:—

> Cultivation of land is performed in severals ways. 1. A series of ploughs revolve in a horizontal axis, the ploughs being raised over the ploughed land; 2. Harrows are worked in a similar manner; 3. Land is cultivated by means of chains having tines or grubbers fixed in them, working longitudinally over two vertical pulleys, one at each end of the machine; and, 4. By means of an endless chain passing over horizontal pulleys or carriages placed along the field, one pulley being on each carriage. To one side of the endless chain a plough is attached, and works alternately between two carriages, the carriages being moved forward as the work proceeds. Thus a carriage on four wheels, one at each end or side of the field, and a locomotive or portable engine in the centre with endless chain and two ploughs, would form the details of the project for ploughing a field of land.

In 1812, Messrs Chapman took out a patent for a "steam-carriage with a 'rigger' working on a stretched chain or rope, secured at both ends by anchors." This principle of "rigger-traction" for giving motion to ploughs has been carried out under numerous modifications by many inventors, and very recently with considerable success.

In 1832, Joseph Saxton patented a system of "differential pulleys," part being applicable to the working of ploughs—an endless rope being used to give motion to a windlass, to which the ploughs, &c. were attached.

In the same year, John Heathcot, Tiverton, Devon, patented a plan of plough-traction by means of a direct pull from a stationary engine. "One end of a drag-rope is fixed on to a long drum, situated longitudinally over the boiler, and in length equal to the length of the field, coiled upon it. The rope then passes to the opposite headland round a large pulley there of an auxiliary carriage, which serves for an anchor. The rope then returns, and

is fixed to the opposite end of the long drum. To one side of this rope the plough-carriage is fixed. The drum is then set in motion, when it coils up the one end of the rope as it gives off the other, the engine-carriage and auxiliary carriage moving along opposite headlands as the work of ploughing advances."

In 1850, Mr James Usher of Edinburgh took out a patent, of which the following is the title: "This invention consists, firstly, in making a series of ploughs in the same plane round an axis, so that the ploughs shall successively come into action; and, secondly, in applying power to give rotatory motion to a series of ploughs, rather instruments for tilling the earth, so that the resistance of the earth to the ploughs or instruments as they enter and travel through the earth, shall cause the machine to be propelled."

We have by no means exhausted the list of patents or plans introduced for steam culture, neither for the purpose of our paper do we think it necessary to do so, our main object in these preliminary remarks being the recording of the "principles" of plans which may be said to comprise the great "classes" under which the various inventions now before the public may be enrolled, and which indicate the principal direction in which invention is at present progressing. These "classes" may be enumerated here as follows: 1. Plans in which the power of steam is applied to the direct dragging of the cultivating instruments—the steam-engine itself, like the horse, passing over the land; 2. Those in which the engine progresses over the land working rotatory cultivators, these forming a part of the machine; and, 3. Those in which the cultivating instruments are dragged over the land either by direct motion or windlass power—the steam-engine not passing over the land to be ploughed. The most important of the machines of these three classes we now propose to describe, leaving for after consideration the question as to which is the best method of bringing the soil into a fine tilth—whether by "ploughs," "rotatory cultivation," or by other methods now occupying the attention of various inventors.

Of the first class of projects the most important yet introduced is "Boydell's endless railway," which, applied to locomotive engines, enables them to traverse the land without injuring it, and which, by greatly facilitating the draught, economises steam or horse power to a large extent. In fact, it has been well named the "steam horse," as by its means all the carting and other work, as well as the cultivating, can be performed by it, superseding horses. It will thus be seen that it is not itself a cultivating instrument, but simply a means by which cultivating instruments, of whatever kind and on whatever principle constructed—as the plough, the rotatory or reciprocating tools—can be used, and this at a cheaper and quicker rate than can be done by horses. It is

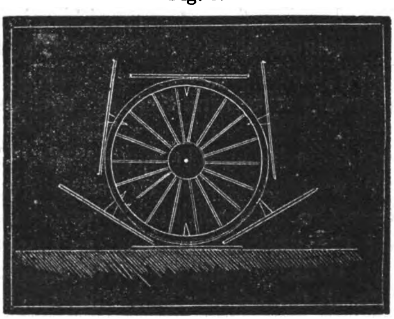
in this way auxiliary to other plans, as, on the other hand, other plans are auxiliary to it.

Like all other inventions designed to supersede either animal or human labour, or at least to greatly mitigate their severity, this has met with its full share of contradictory statements—one giving undue praise, the other dealing out as undue censure. We believe the middle course is the correct one. There can be no doubt that it *can* drag heavy weights over soft and unyielding soil, and overcome obstacles in its path with astonishing ease; at the same time there are defects in the arrangement of the mechanism, and other difficulties in the way, yet to be overcome before the "traction-engine" can be said to be a thoroughly successful invention. These, however, are points which experience will doubtless make clear; certainly the successful solution of the problem opened up by it is worthy the best and untiring efforts of any inventor.

The original patent was taken out in 1846, and was for apparatus which "consisted in the application of movable detached parts of a railway to the wheels of carriages, whereby each part is successively placed by its wheel on the road or land over which the carriage travelled, each part of the portable railway, when down, allowing its wheel to roll over it, the wheel depositing and lifting the parts of the railway in succession." In 1854 a second patent was taken out for improvements, consisting "in the application of side-pieces to each portion of the movable rails, so as to obtain a more extended bearing for the rails whilst the wheel is passing over them; and for the construction of parts of the portable rails, by combining tough iron and wood to obtain great strength with lightness."

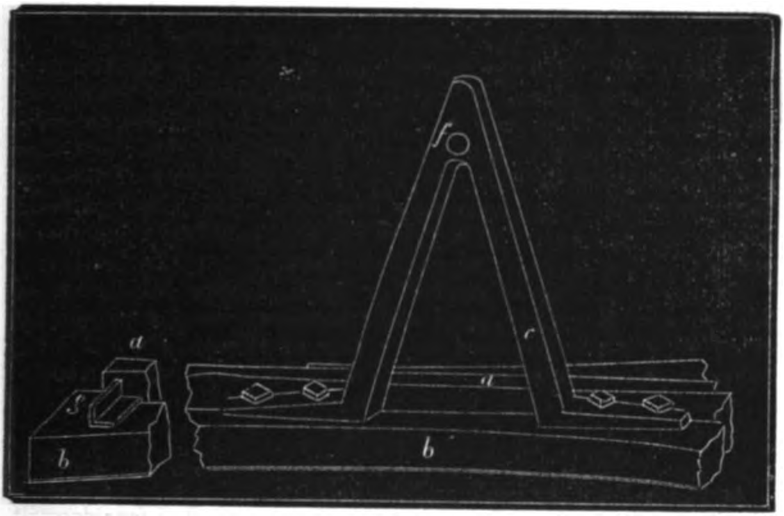
In fig. 1 we give a diagram illustrative of the arrangement of a wheel with the parts of the endless railway attached; fig. 2 being a view of one of the separate parts of which this is constructed; and fig. 3 that of one of the double guides fixed to the side of the wheel, by which these parts are lifted from and deposited on the ground in succession. The parts of the rails on which the wheels run are affixed to a plate, of which the surface is considerably wider than that of the tire of the wheel. By this arrangement a broad-bearing surface is afforded, preventing the sinking of the wheels into the soil. The ends of the bearing-plates match into each other, and extend beyond the portion of the rail fixed to them. This is done so that when the wheel arrives at one end of a portion

Fig. 1.



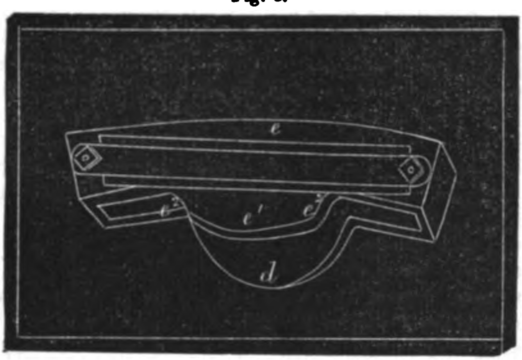
of the rail, a portion of the bearing-rail is still left over, and the wheel is received on to and supported by the portion of the rail on the succeeding bearing-plate before it leaves the bearing-plate of the previous part. In fig. 2 each portion of the rail *a* is fixed to

Fig. 2.



the bearing-plate *b*, to which a triangle *c* is affixed; this passes between the guide-plates *d e* (a pair of which are shown in fig. 3) affixed to the side of the wheel, a pair being given to each bearing-plate. A stud or pin *f* is attached to the triangle, and the guide-plates have raised pieces e^1, with hollows or notches e^2; stops *g* are also provided, one on one end of the bearing-plate, the others projecting from the side of the wheel in certain positions, six of these projecting stops being applied to it. There are thus twelve stops —one to each of the six bearing-plates, and six to the wheel. These studs *f* and stops *g* are necessary to lay the bearing-plates correctly on the ground, in manner following: On the wheel

Fig. 3.



revolving, the stud *f* of the bearing-plate enters the farthest notch e^2 in the guide-plate, whilst the projecting stop of the wheel takes into the stop *g* in the bearing-plate. Similar stops may be applied in the opposite position to assist in backing the wheel, and the bearing-plates will be taken up or lifted correctly by the studs *f* coming into the back notch of the guide-plates *d e*, the other end of the bearing-plates coming into contact with the stops. By these arrangements the parts of a portable railway will at all times be laid down and taken up correctly, notwithstanding the bearing-plates are detached, and independent of each other.

The invention has been applied in numerous instances to ordinary carts and waggons, and by the authorities at the War Office for the dragging of heavy guns over yielding surfaces: for this latter purpose it has been very successful. It is also becoming largely applied to portable steam-engines, enabling them to do much of the carting operations of the farm.

In the beginning of September 1856, Messrs Middleton, of Hatton and Hanworth, used the traction-engine for ploughing purposes, the ploughs used being four of Howard's "P P" for common or surface work, and two of Cotgreave's patent trench-plough for subsoil. The following account of the operation is extracted from the *Mark Lane Express* of September 22, 1856:—

At Steam Farm the work performed was trenching, this being done about twelve inches deep, the engine travelling at a speed of from one and a fourth to one and a half of that of the horse-team in the field adjoining. The soil tried the implement severely; for although gravelly, it was yet so bound together, and rocky hard in the bottom, as to set the subsoiling part at defiance in many places. . . . But stubborn as it was to the ploughs, and presenting a great resistance to the engine, the latter could have hauled another plough, as it was never working up to its full pressure of steam. Two ploughs, however, were all that were at command, and with these it was doing at the rate of about *five acres per day*. The quality of the work gave universal satisfaction, especially to the market-gardeners of the neighbourhood, who offered to give 30s. per acre for such trenching, assuring the patentee and Mr Middleton—who lets out engines—that a large area of land could be had at this rate among the market-garden grounds of the capital. . . . In two other large fields on Steam Farm a considerable extent of land was ploughed about nine inches deep. In both the work was executed in a superior manner, the furrows being straight and well laid. Both fields, we may observe, were well adapted for traction engine-work, being comparatively level and of great length. At the second farm in which the experiment was tried the field was of a more friable gravel, about the same inclination, and nearly half a mile long. In this trial, as the "furrows were equal in depth and width, and well laid, the work went on with a clock-work mechanical sort of regularity, giving to the whole affair an established character." . . . All unhesitatingly acknowledged that each plough was doing more than an ordinary "four-horse power," and that such work could not be done in the district for less than 20s. per acre with horses, while

with steam it did not cost 3s. 6d., or at the utmost 4s. . . . The details of expenses may be thus stated :—

Engine-man or stoker, 4s. per day, . . .	£0 4 0
Steersman and four ploughmen, at 2s. 6d. per day, .	0 12 6
Ten cwt. of coal, at 1s., ...	0 10 0
Tear and wear of engine, ...	0 10 0
Total expenses per day, . . .	£1 16 6

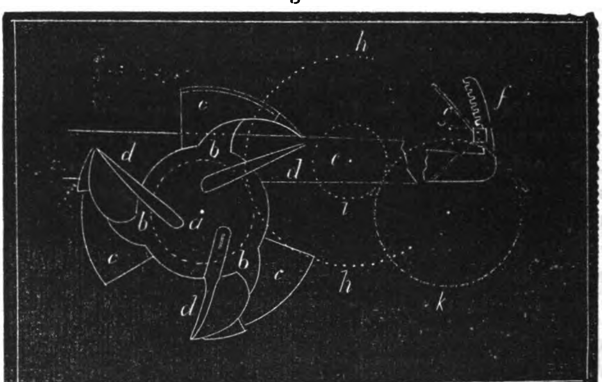
The estimated capital sunk in the purchase of the plant may be set down at £600. Of course, to make it pay at the rate as above quoted, the engine must be in constant use; for, like all mechanism where steam-power is employed, to obtain the full economical effects, constant work must be exacted of it. This circumstance, and the great cost of the apparatus, will preclude its use by the majority of farmers—at least its exclusive use for cultivating purposes. In one way the difficulty may be got over, by parties erecting engines and supplying the necessary plant, and letting them out in manner similar to that done by the owners of thrashing-machines; and in another and perhaps more satisfactory way, by employing the "traction-engine" for all purposes where horses are at present employed—as for carting off produce from, and manure to, the fields, as well as for the ploughing and cleaning of the land, and also for the sowing of the seed. This last consideration reminds us of what will indeed be not the least striking feature of the revolution which the employment of steam for cultural purposes will effect in all the departments of the farm. For it is quite evident that it will never in any sense pay to employ steam to do the principal part of the work of a farm—the steam culture and steam thrashing—while horses are kept in lazy luxuriance in their stables, only to be brought out when carting off produce or manure is required. Half measures will in nowise do. A horse, mechanically speaking, is at the best an expensive kind of traction-engine, and if this is allowed to remain a large portion of its time idle when the engine is employed, and on the other hand the steam-engine idle when the horses are employed, the result, in a pecuniary sense, would be similar to that obtained by "lighting the candle at both ends,"—more light might be had, but the ratio of the expense would be much higher than that of the good effected. If, then, steam is to be successfully employed on the large scale, it involves a much wider change in farm operations than is generally believed. That steam is capable of entirely superseding horses, we firmly believe. "As surely," says a well-known graphic writer, "as steam-power has become the substitute for wind, water, and animals in the processes of grinding, beating, pumping, lifting, and propelling, in mills, in farms, in mines, and in land, river, and sea; so surely will it be the means of performing like operations on

farms, in ploughing, harrowing, and transport, and yet other things, till such time as a new motion shall be discovered, combining equal power with diminished weight of machine." But the points involved in this department are of such importance, and the considerations so pregnant with interest to the practical man, that we propose still further taking them up, and showing their close bearing on the question of steam culture. This we shall leave to the concluding section of our paper.

We now come to the consideration of the second class of projects—namely, those in which the engine passes over the land, working rotatory cultivators, these forming a part of the machine. The best known of this class are those of Usher, Hoskyns, and Romaine—the first of these being the earliest in point of date.

Usher's steam-plough has been so repeatedly before the public that few are unacquainted with its leading peculiarities; but as we desire to make our article in some degree a record of what has been proposed, and as some of our readers may be unacquainted with the arrangement of its mechanism, we here give a short account of its leading peculiarities. The invention consists of two parts: *First*, The mounting a series of ploughs in the same plane round an axis or shaft, in fig. 4. To this shaft are attached

Fig. 4.



a series of plates or discs, fixed at equal distances. To these the ploughs are attached, the under edge of the mould-board and share of each of which is struck to a curve from the centre of revolution *a*. These ploughs, in revolving, penetrate the soil, and by their mould-boards turn it over. Each of these discs has attached to it three arms or projections, as *b b b*, terminating in the radial direction as shown in the drawing *a*. To these arms the tilling parts are affixed. These consist of the parts *c c c*—those acting as the mould-board in the common plough. To the fore-part of the mould-board a wrought-iron bar

is affixed, forming a head or share bearer; to this the share is adapted and fixed by its socket. Adjustable coulters *d d d* are affixed in front of each share. By this arrangement each plough in one disc follows successively into action; and the ploughs on the other discs are so arranged that no two of them will come into action at the same moment.

The plough-shaft *a* has its bearings at the end of an adjustable or swing-carriage, which vibrates on the centre at *e*, and the extremity of which, at *f*, is formed into a rack, which is operated upon by a small pinion, worked by the loose handles *g*. In this way the ploughs can be taken up out of contact with the ground at the pleasure of the attendant. The *second* part of the invention consists in applying the power of a steam-engine to give motion to this shaft, with ploughs attached, in such a manner that "the resistance of the earth to the ploughs or instruments as they enter and travel through the earth shall cause the machine to be propelled, thus making the ploughs act in the earth in the same way as paddle-wheels do in the water, by which the vessel is moved along."

The movable frame *f e d*, fig. 4, supporting the rotatory ploughs, is connected with the carriage-frame, which carries the steam-engine and boiler—the former being of the horizontal species. To the front of this carriage-frame a pair of running-wheels are provided; these are mounted in bearings, attached to a horizontal swivel frame, part of which is provided with a circular rack, into which a pinion works: by turning the handle connected with this, the swivel frame is turned round in any direction required, and the machine is thus made capable of being turned at the headlands in a comparatively small space.

The following are the movements by which the machine progresses, and the rotatory cultivators are worked. To the crank-shaft of the steam-engine a pinion is keyed; this takes into a spur-wheel *h h* (fig. 4), carrying a second pinion *i*, which again takes into a spur-wheel *k* fixed on the shaft of the cylinder roller, bearing on the soil. By this arrangement a slow progressive motion is given to the machine. The spur-wheel *h h*, taking into a pinion on the shaft *a* of the rotatory cultivator, shown by the dotted lines, gives, at a slightly increased speed, revolution to the plough-shaft. Deferring our remarks upon this machine till the concluding portion of our paper, we proceed to give a description of other projects.

The next plan we have to notice is that promulgated by the celebrated author of *Talpa, or the Chronicles of a Clay Farm*, Chandos Wren Hoskyns, Esq. While other plans have for their object the pulverising of the soil, by an action similar to that of the common plough, this proposes to introduce a new principle of action—namely, the abrading or rubbing down of successive

portions of soil, until a fine tilth of considerable depth and of somewhat uniform quality is obtainable. This abrading action is produced by the rapid rotation of a series of cutters, a slow progressive motion being given at the same time to the machine to which these cutters are affixed—this progressive motion being regulated according to the nature of the soil; but when so adjusted, is maintained at a uniform speed relative to that of the cutters. The cutters produce and maintain a trench of a given depth, in which it works and cuts down or abrades the soil on the land side, and deposits it behind in "an inverted, comminuted, and aerated condition."

As the motion of progression, or the advance laterally of the cutters, must bear a strict relation to the velocity of their rotation, the principle of self-locomotion forms an important feature of this invention.

The main driving-shaft is actuated by two horizontal steam-engines (A A)—one on each side of the bed-plate of the framing. On the centre of the shaft (B), between the two cranks, an endless screw (C) is placed; this takes into a screw-wheel (D), keyed on to an angular shaft (E), at the lower end of which is a small bevel-wheel (F) working into a face or larger bevel-wheel (G), fixed vertically on the horizontal axis (H) of the two driving-wheels which give progressive motion to the machine. These driving-wheels are of considerable breadth of tire, in order to have as little influence in cutting up the land as possible; and to insure their "bite," the inventor proposes to place horizontal ribs or projections at intervals in their periphery. The shaft of the driving-wheels is thus situated below and a little in advance of that of the engine.

The shaft (I) supporting the rotatory cutters or tillers is a little in advance of that of the driving-wheels. This is not permanently fixed, but is capable of sliding up and down between two guides, one on each side of the frame. The bushes in which the shaft revolves have screws attached to them; these are provided with screw-wheels, taking into endless screws at each end of a small horizontal shaft, actuated by a winch or handle at one end. By turning this handle, the endless screws are made to revolve, and entering into the screw-wheels fixed to the ends of the screws affixed to the bushes or bearings of the shaft of the cutters, these may be raised or lowered as desired, and their parallelism insured.

The "tiller" consists of a series of rings or cutters fixed on the central shaft (I), each of which is provided with two cutters, shaped at their extremities like the tool of a paring or slotting engine. These cutters are inserted in slots formed in the arms of the ring diametrically opposite each other, so that they can be moved outwards or inwards towards the centre of the ring, and their extremities project accordingly beyond its entire periphery. The discs or rings

supporting or carrying these cutters are so placed on the shaft that the whole breadth of cutters do not act on the soil simultaneously, but in succession. By this arrangement the cutters have a self-cleaning action, and lapping, as it were, over one another, no portion of soil is left uncovered from the land side. Behind the tillers is placed an inclined board, termed a "tail-board;" this is mounted on a shaft adjustable by a lever, and is used to "regulate the fall of the soil and the equalisation of the tilled surface." The tiller shaft (I) is set in motion by chains passing round the wheels (K K) at each end of the engine-driving shaft (B). The relative speeds of the tiller-shaft (I) and the driving-wheels may be regulated by a change of chain-wheels, these being provided of different diameters; or the same may be effected by a change of the gear which gives motion to the driving-wheels from the shaft of the engine. The speed or rate of working the engine may also be regulated so as to produce a slower or quicker rate of progression.

Another feature of this invention is the means adopted by which the rotatory motion of the tiller (I) is maintained while that of the driving axle (H) is stopped. The large bevel-wheel (G), which enters into the small one (F) on the end of the shaft (B), which is moved by the engine-shaft, is placed loosely on the axle of the driving-wheels, and is provided with a clutch-box. The sliding clutch, which is moved on the shaft by means of a lever, is always in contact at one end with the clutch-box on the driving-wheel, and can be moved along so as to enter into the clutch-box of the large bevel-wheel. By this arrangement the progressive motion of the machine may be suspended, while the rotatory motion of the cutters is maintained.

We have as yet noticed only the two main or large driving-wheels—these partaking most of the character of wide rollers. We have still to notice the two steering-wheels placed at the front of the machine. These are also very broad-like rollers. They are mounted to facilitate the turning up the headlands, with a central bearing which is free to turn a pin as a centre. A circular rack is provided, with a curve described from the centre of the pin above referred to. The centre bearings of the axle are connected with the framing of this circular rack, and are free to slide thereon. By turning winches or handles connected with pinions which centre with the rack, the bearings are slid round so as to incline the axle to the carriage, causing it to move out of the direct line. To assist in turning the carriage round, in addition to this inclining of the axle of the steering-wheels, the patentee furnishes the driving-wheel axle with two clutches somewhat similar to that already described, one to each driving-wheel. This arrangement enables the driving-wheels to be thrown out of gear together, or one to be driven one way, the other the other, by this means facilitating the turning of the machine. At the turning, the tiller is raised out of contact

with the ground, this being effected by turning the handles of the endless screw-shaft already described.

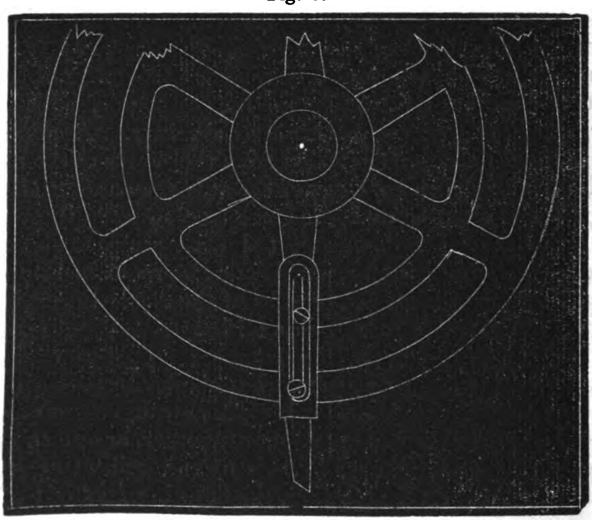
The following is the action of the machine. The engine is arranged to give sixty strokes a-minute, the driving-wheels making one revolution only during this period, the tiller one hundred and twenty. Making the circumference of the driving-wheels in inches equal to this—one hundred and twenty—one inch of progression of the driving-wheels will be made for one revolution of the tiller. But as there are two cutters in each ring at opposite ends of its diameter, two cuts of half an inch will be given at each revolution, thus giving two hundred and forty cuts per minute for each revolution of the driving-wheel. This gives a cutting of the soil equal to two hundred lineal yards per hour.

The following is a table of the principal movements:—

The horizontal engines (A A)	give motion to
The shaft (B),	on which is keyed
The endless screw (C),	giving motion to the
Screw-wheel (D),	keyed on to the upper end of the
Angular shaft (E),	in the lower end of which is the
Small bevel-wheel (F)	taking with the
Large do. (G),	keyed on the
Horizontal shaft (H)	of the main running wheels.
To the shaft (B)	are keyed
Chain-wheels (K K),	giving motion to chain-wheels fixed on the
Tiller shaft (I).	

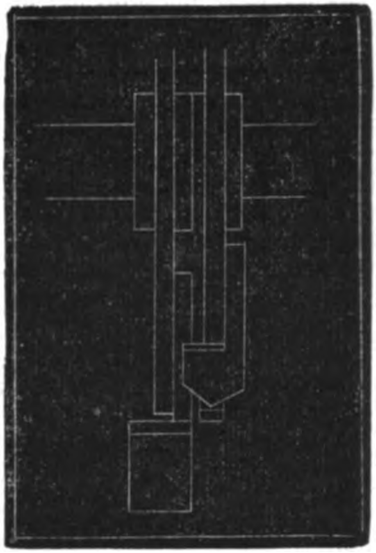
In fig. 5 we give a half view of one of the cutter-rings, and at fig. 6 two of these rings in edge view, with their cutting joints or instruments attached.

Fig. 5.



Next in point of date is the rotatory cultivator of Mr Romaine of Canada, introduced to the notice of agriculturists mainly through the exertions of Mr Mechi. In its general appearance this machine has a close resemblance to that of Mr Hoskyns just described. There is this important difference, however, between them; in Mr Hoskyns', the power employed to work the cultivator also makes the machine progress; while in Mr Romaine's the machine is dragged over the ground by horses, the steam-engine-working only the cultivator. This is a serious defect, as we well know that of all traction-engines the horse is the most expensive. It has, however, been obviated in the improved machine hereafter to be described. The following is as clear a description of the whole arrangement as we can give without the aid of drawings:—

Fig. 6.



At the extremity of the framework of a common box-cart, a vertical boiler and steam-engine is placed, these being a little in advance of the main running-wheels, these being 5 feetin diameter, and of considerable breadth of tire, to prevent them from sinking into the ground. The hind or smaller wheels revolve on the two extremities of a hollow axle, supported by a fixed framing (A), which is connected at one end with the axle (B) of the main driving-wheels. The framings on each side are tied together by a horizontal bar or stay, in this way leaving a clear space between the two. Outside this framework, and extending to a distance of 8 feet behind its extremities, a second framing is arranged; this has the extremities of its side-pieces working on the main axle as a centre, while the opposite ends are connected together by a transverse bar. The further extremities of the framing are widened out so as to support the brass bushes in which revolves a horizontal axle or shaft (C), to which a roller is connected, this having two or more discs to which the cultural or cutting knives are attached. As the ends of the framing are jointed to the axle, it is capable of being raised or lowered at its outer extremity, thus raising or lowering the revolving cutters there attached. This is effected by means very similar to those employed by Mr Hoskyns. Through the centre of the cross bar or stay, between the sides of the frame first

mentioned above—namely, that supporting the smaller or hind wheels—a screw works, this being actuated by an adjusting wheel placed horizontally. The lower end of this screw is connected with the centre of the cross bar or tie of second framing described; namely, that which supports the revolving cutters. As the adjusting wheel in the fixed frame is turned to the right or left, so does the screw raise or lower the frame suspending the cutters, its extremities being supported by, and working upon, the main axle as a centre.

The "cutters" having thus a capability of adjustment given them, by which any required depth of operation may be attainable, the next point to be attended to is the method of imparting motion to them. This is attained by the following arrangement: Immediately above the shaft or axle of the revolving cutters another horizontal shaft (D) revolves. This is provided with a spur-wheel (E), which takes into a pinion (F) keyed on to the cutter-shaft (C). On the upper shaft (D) a bevel-wheel (F) is keyed, this being worked by another bevel-wheel (G) attached to the end of a shaft (H), which receives motion from the main driving-shaft through the intervention of corresponding bevel-wheels. This shaft is supported by the "second framing" by a suitable bearing. But as the framework to which the revolving cutters and their driving-gear are attached is made to rise or fall, if no provision were made, the bevel-wheel (F) in the upper horizontal shaft (D) would fall out of gear with that attached to the shaft which receives motion from the engine, but the connection between them is maintained, no matter what the position of the shaft driving the cutters, by the following arrangement: A tubular bearing (J) is made to fit loosely on the axis of the axle of the main running-wheels; on this the inner extremities of the shaft (H) are supported. The main driving-shaft (K), on which the bevel-wheel (L) is keyed, which gives motion to the shaft (H), is made tubular, and revolves loosely on the axle (B). To this (K) a pulley (M) and fly-wheel (N) are attached. On a line with the axle (B), but a little in advance, is another pulley (O), to a stud on the face of which, at a distance from the centre, equal to the stroke of the engine, the lower end of the connecting-rod (P) of the steam-engine is attached. A chain or driving-belt passes round the pulleys (O) and (M). The following is a table of the movement:—

The pulley (O)	receives motion from
The connecting-rod (P)	of the engine, and by the chain or driving-belt passing round the periphery of
The pulley (M),	imparts motion to the
Tubular shaft (K),	on which the
Bevel-wheel	is keyed to the extremity of
The shaft (H);	on the other extremity of which is fixed the second
Bevel-wheel (G),	taking into the
Bevel-wheel (F),	fixed on the

Shaft (D),	on which is keyed the
Spur-wheel (E)	taking into the
Pinion (F)	on the
Cutter-shaft (C).	

The whole apparatus is dragged over the ground by the horses, these being placed before.

This, the first patented apparatus of Mr Romaine, has not answered expectation. The inventor is not, however, discouraged, but is ardently prosecuting his experiments, and has very recently taken out a second patent embodying improvements on the first. These involve considerable differences in the details, which it will be necessary here to notice.

The engines are horizontal, not vertical, as in the former case, and are supported—one on each side of the boiler—by an open framework, between the sides of which the vertical boiler is centrally placed. The framework is supported by two large loose running-wheels, the axle of which is bent so as to pass under the boiler: these running-wheels are very broad in the tire. The framework is extended forwards in front of the boiler to a considerable length, and supports at its further extremity a bearing, in which revolves the horizontal shaft of a land-roller, which is used to relieve the framework of a portion of its weight when in action. About midway between the axle of this roller and that of the large running-wheels, the frame is made to extend downwards to provide a bearing for the horizontal axle (A) of the cultivators or cutting implement. The depth to which the cutters operate is not adjusted in the manner adopted in the first machine, but is simply effected by making the framework vibrate on the axle of the main driving-wheels, and "tipping" it up to any desired elevation by means of a rope and small windlass fixed at the end of the machine opposite to that at which the cutters work.

The mechanism for driving the cutters is as follows: On each end of the shaft (A) of the revolving cutter a bevel wheel (B) is keyed. These are concealed in the open ends of the revolving cylinder, so that this can work quite close to the ground without disturbing the action of the gearing. Smaller bevel wheels (C C) are keyed on to the foot of vertical shafts (D D), to the upper end of which cranks (E E) revolving horizontally are keyed, and to which the connecting-rods (F F) of the horizontal engines (G G), one at each side of the framing, are connected. The vertical shafts (D D) have their bearing in the framing. The following is a table of the movement:—

The motion of the horizontal engines (G G)	is communicated to the
Vertical shaft (D D)	through the intervention of
The connecting-rods (F F)	and
Horizontal cranks ;	this again is communicated to the
Shaft (A) of the revolving cutter	by means of the
Bevel-wheels (B C C).	

A progressive motion is given to the whole machine, and the cutters are kept well up to their work, by the following means: Parallel to the axle of the main running-wheels a shaft (O O) is made to revolve in bearings on each side of the framing. This carries at each end a pulley or rollers made of India-rubber or other elastic material. The length of these pulleys a little exceeds the breadth of the tire of the main running-wheels, and against which they revolve in close contact. The friction of the rollers against the periphery of the running-wheels causes these to revolve and make the machine move forward. The rollers are also capable of revolving in the opposite direction, causing the machine to go backwards and release the cutters from the soil by the following mechanism: To the vertical shafts (D D) a bevel-wheel (H) is keyed horizontally; this takes into a vertical bevel-wheel (I) keyed on to a horizontal shaft (K), having its bearings in vertical "hangers" fixed to the side-framing. A movable "clutch" (L) is attached to (K), and is provided with a bevel-wheel (M) at one end, and a corresponding one (N) at the other. These take into a bevel-wheel (P) fixed at one end of the shaft (O O) bearing the elastic rollers, according as the clutch is moved backwards and forwards.

The vertical shaft (D D)	driving the
Cutter-shaft (A)	gives motion to the
Bevel-wheel (H),	and this
Horizontal shaft (K)	through the medium of
Bevel-wheel (I),	supposing the "clutch" is moved so as to put the
Bevel-wheel (M)	in gear with the
Bevel-wheel (P),	the elastic rollers revolve, so as to move the driving-wheels forward; but if the clutch is moved so as to put
The bevel-wheel (N)	in contact with
The bevel-wheel (P),	the rollers are driven so as to make the machine move backward.

The clutch is operated upon by levers, the handle of which is placed at the front of the machine.

This system of driving-gear may be easily disengaged by means of a quick screw-movement, which shall draw the elastic rollers into contact with the peripheries of the running-wheels. The inventor, in the drawings he has published, has shown a pair of screw-spindles fitted with foot-levers, by means of which the attendant can keep the rollers hard pressed up against the wheels; or, by reversing the screw, can release them altogether. The following is a description of the digging apparatus: The shaft carries a cylinder provided with a set of radiating arms, to which the knives or cutters are attached. These arms are set at equal distances apart upon the cylinder, and the knives or bars are screwed or riveted to their outer ends. The edges of these bars, which may

be either plain or serrated, are so set, that on the revolution of the cylinder they are the most favourably disposed for entering and cutting the earth; and they are made either parallel with the axle, or set spirally or inclined thereto; or the bars may be formed of double angular lengths, so as to present points and angular surfaces during working. Curved picks may also be attached to the digging cylinder.

In fig. 7 we give a transverse sectional detail of portion of the cylinder with the cutters attached, and in fig. 8 a transverse section of the cutting knives or bars. It may interest our readers to know, that this machine is the one aided by funds voted by the Canadian Legislature, which is "taking the lead in promoting cultivation by steam." Mr Romaine fully anticipated a public display of the powers of the apparatus at the recent Agricultural Exhibition at Paris, but a variety of difficulties which arose in perfecting its details, prevented this. Mr J. Evelyn Denison, M.P., who, at the request of our Government, drew up a Report of the Exhibition, thus speaks of the machine: "Still it is just to Mr Romaine that I should bear testimony to what I saw, and to the point which he had attained. I saw, in a field near Paris, Mr Romaine's machine, carrying its own boiler and engine, travel by its own locomotive power 100 yards up one field, and break up and cultivate the land in its course."

Fig. 7.

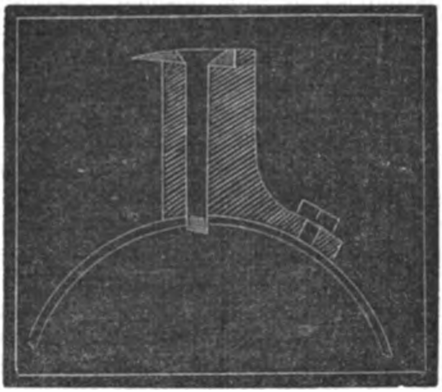


Fig. 8.

(*To be continued.*)

SCIENCES APPLICABLE TO AGRICULTURE—GEOLOGY.

(*Continued from page* 450.)

GRANITE is composed of quartz, felspar, and mica,—the granular structure so distinct that the separate ingredients can be easily recognised. The felspar, which consists chiefly of silica, with a considerable proportion of alumina and potash, is most liable to decomposition; and in some varieties of the rock this process is so rapid, that it is called the granite sickness. The decomposed felspar covers the ground in the form of a fine powder, which is collected in large quantities in Cornwall and elsewhere, and used in the manufacture of porcelain and other articles of pottery. It is, therefore, an abundant ingredient in the soil of primitive districts; and it is by no means confined to these, for it is of very general occurrence among mountain rocks. In an earthy state, somewhat resembling claystone, and often very hard, it is a common constituent of porphyry rocks, such as the Cheviots and Pentland Hills in Scotland. In these cases it is frequently of a rather deep red colour, caused by a greater infusion of peroxide of iron; and this produces a red-coloured soil, such as that which surrounds the base of the Eildon Hills, rendered more conspicuous in that locality by the paler hue of the greywacke soil by which it is encompassed on all sides. Mica, the other constituent of granite, is readily distinguished by its shining metallic lustre, which has caused it, in some of the northern districts where it abounds, to be named *sheep's siller*. In this mineral, silica still predominates; but alumina is in large proportion, and potash in considerable quantity; part of the potash occasionally replaced by protoxide of iron or manganese, and of the alumina by the peroxide of these metals, or of chrome.* In some varieties, magnesia is present in some quantity, and these are named magnesian mica, to distinguish them from the common one, which is called potash mica. These, however, seem rather to be accidentally disseminated in mountain rocks than to form an essential constituent of them. The three ingredients of granite are easily distinguished by their degree of hardness; the knife makes no impression on quartz—felspar yields to it a little—and mica is easily cut. This latter substance is divisible into inconceivably thin scales; and owing to its divisibility, in connection with its lightness, it has been so generally diffused that it is met with more or less in nearly all the sedimentary rocks. The only other substance of those mentioned

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* 48.00 sil.; 34.25 alum.; 4.50 perox. of iron; 8.75 potash, in 100.—KLAPROTH.
47.50 " ; 37.20 " ; 3.20 " " ; 9.60 " in 100.—ROSE.

above as contributing to the formation of rocks, that resembles it, is talc, which likewise appears in thin translucent plates of a white or bluish colour. These plates have a more distinctly greasy feel than mica, and may at once be distinguished by being flexible, but not elastic, both of which properties are obvious in mica.

What are called the primary schists—at least a certain class of them—consist of the same substances as granite, from which, indeed, they have been formed. The materials of granite seem to have frequently been broken up and comminuted in those vast convulsions which have had so important a part assigned them in bringing the crust of the earth into its present condition. They have been tossed about and abraded in a constantly and violently agitated ocean, from which they at length subsided and became consolidated under the influence of a high temperature. Such seems to be the origin of gneiss and mica slate, two rocks of much importance in Scotland, from the great extent of area which they cover. They are composed of laminated or flattened pieces,—the gneiss with all the three ingredients of granite, and the mica slate with only two of them—the quartz and mica.

Granite, then, and the two stratified rocks formed from its altered materials, are great reservoirs of silica, as it abounds in all their ingredients; and it is from this source that it is obtained by many of the other formations subsequently to be noticed. Alumina is also present in considerable quantity; potash in pretty large proportions; and the peroxides of manganese and iron. We shall afterwards consider the characteristic qualities of the soil formed from these rocks, and the variations to which it is liable from the occasional presence in them of other minerals besides those already mentioned; but we must first bestow a brief consideration on the other stratified formations, taking them in the ascending order as lying above those already referred to.

Associated with the gneiss and mica-slate, under the general name of *metamorphic rocks*, is primary clay-slate, a substance familiar to us from the various useful purposes to which it is applied. It forms a fine-grained argillaceous mass, of considerable hardness, and of a glistening aspect, remarkable for the readiness with which it admits of being split into thin plates. It is supposed to have derived its materials from the further disintegration of the gneiss and mica-slate, as the quartzose and micaceous particles still appear; and it is probable that it is in a great measure owing to the manner in which the latter are arranged that it owes its fissile properties. The long-continued action of water and of the atmosphere has reduced the clay of the felspar to an impalpable sediment; and in the course of its consolidation, under the influence of heat, its chemical constitution has been changed, and it has acquired that peculiarity of structure which is denomi-

nated *cleavage*. Its geographical distribution in this country will be afterwards noticed along with that of the other rocks.

The Silurian system is the next in succession, comprehending the upper and lower silurian groups; and these, again, subdivided into others, distinguished by the local names of Ludlow, Wenlock, and Llandeilo rocks. They were formerly called, and still continue to be so by some writers, greywacke, or transition rocks; terms which, whatever view we may take of their origin, are preferable to local names. "The system consists in the main of alternations of flagstones and sandstones, of argillaceous and calcareous shales, of clayey limestones, and limestones of a concretionary structure."* It includes all the strata that lie between the primary clay-slates and the old red sandstone, and is the first formation, in point of time, in which a few animals of lowly forms appear, the dawnings of that exuberant life which afterwards peopled the early world. In Scotland this formation is important, from the extent of surface which it occupies, including a large proportion of the southern division; although it does not appear elsewhere, at least on a large scale. In that locality the rock is generally of a bluish-grey colour, composed chiefly of grains of quartz and clay-slate, with an intermixture of small mica scales, usually fine in the grain, but sometimes rather coarse, in which case small pieces of jasper and other substances are occasionally interspersed. The rock passes into what is to all appearance clay-slate, usually called transition clay-slate, to distinguish it from the primary kind mentioned above, thin layers of which usually lie as if compressed between more compact and massive portions of the strata. The latter almost invariably lie at high angles, and are not unfrequently quite vertical.

Interposed between this and the carboniferous system, or coal-formation, we find the old red sandstone, or Devonian, as it has been often called. As chiefly a sandstone, it is composed of particles of quartz and laminated clay, varying in consistency from hard compact building-stone to soft crumbling earth. A close-grained fissile flagstone is not unfrequent, and an important member of the series is the conglomerate, consisting of rolled pebbles of various sizes, of every description of the older rocks, the accumulations probably of ancient shores. Soft and friable shales, most variable in colour, are interstratified in thin layers among the other beds. Although many of the sandstones are white, the great mass of this formation is of a reddish-brown colour, being deeply impregnated with peroxide of iron, which must have filled, almost to saturation, the waters from which many of its beds have been deposited. The limestones associated with

* PAGE'S *Text-Book of Geology*, 63.

these strata are usually called *cornstones*. They are coarse, porous, and silicious, with veins of quartz, jasper, &c., and other foreign matter. They have been frequently burnt for quicklime; but the attempt is generally abandoned after a trial, as the product is scanty, and ill-fitted for agricultural purposes, owing to the presence of a large quantity of magnesia.*

The carboniferous system which succeeds this embraces the coal-measures, mountain limestones, and carboniferous slates. The sandstones, which are well known as our most valuable building-stones, are usually composed of white quartz particles, variable in size, the hardness varying with the nature of the cementing medium, which is sometimes likewise quartzose, at other times calcareous. Some of these sandstones are known in England by the name of *millstone grit*. They alternate with shales of different kinds, bituminised in the same manner as coal, clays, ironstones, and limestones. The limestone of this formation, called mountain limestone, because generally found on the sides or summits of trap hills—is a dark-coloured grey or bluish rock, very compact, and of a hard and durable texture. It often forms thick beds; at other times it appears in numerous thin layers, interposed among the shales, which thus appear to predominate. The whole is filled with, or in a considerable degree composed of, the remains of corals, encrinites, shells, trilobites, &c.; and when polished and used as marble, these give a curious appearance to the surface. This is the most valuable of all the limestones, viewed in an economical light, as it affords the best material for building, mortar, and for all agricultural purposes.† It would of itself render this system valuable; but when taken in connection with the coal, ironstone, and building-stone, which it affords in such abundance and excellence, it acquires a pre-eminence in usefulness to man with which no other admits of comparison. Considering both its organic remains and lithological structure, it is evident that it has been deposited under very different circumstances from any of the stratified rocks we have hitherto referred to. The land, up to this time confined to comparatively limited areas, had now become extended into wide-spreading districts, admitting of the accumulation of large rivers and extensive fresh-water lakes and marshes. To a considerable extent, therefore, marine productions, which hitherto predominated, began to be superseded by a land vegetation. The exuberance, but not the variety of vegetable life, in particular, is very remarkable, and implies the action of causes of fertility

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* 43.64 carbonate of lime, 33.49 carbonate of magnesia, 21.50 silicious matter, 1.06 oxide of iron and alumina.—Johnston.

† This limestone consists of lime in combination with carbonic acid, the former in the proportion of 56.3, the latter 43.7 per cent. In other words, a ton of carbonate of lime contains 11¼ cwt. of lime.

not now in operation. It was probably owing, in some measure, to a large proportion of carbonic acid in the atmosphere, as it must have been from the atmosphere that plants yet derived the greater part of their nourishment, for little vegetable soil could yet exist. Inundations uprooted and transported this teeming vegetation to the mouth of rivers, and deposited it in estuaries, while other catastrophes led to its being overlaid by great accumulations of mineral matter. Animal life on land was, however, by no means on a corresponding scale of magnitude; animals were few in number, of inconsiderable dimensions, and still belonging to the less highly organised tribes. Instead of the singular vegetation of the period being consumed in the support of huge herbivora, such as those that afterwards appeared, its destination seems to have been to be stored up for the use of man, for whose appearance and well-being, as the crown and consummation of the present economy of things, we can observe so many provisions made from the earliest dawn of geological times.

The coal-measures are succeeded by a series of sandstone strata, magnesian limestones, and variegated shales and marls, known collectively by the name of New Red Sandstone System. It comprises two groups, the Permian and Triassic; the former including the lower members of the series, the latter the upper. The marls and sandstones of the inferior beds are not unlike those of the coal-measures, into which they sometimes pass almost insensibly. The magnesian limestones are characteristic of the middle part of the system; they are white or yellowish—brown and grey; in general, small, granular, and glimmering or glistening. Other varieties are of coarser grain, and even made up of small fragments, like a kind of conglomerate. The ingredients are in the following proportions:—Magnesia, 48.3; carbonic acid, 51.7; so that 1 ton of carbonate of magnesia contains 9⅔ cwt. of magnesia. Along with these there is a trace of alumina, oxide of iron, and phosphoric acid, and generally a trace of insoluble matter. The variegated marls in the upper part of the system frequently contain gypsum or sulphate of lime, a substance extensively used for promoting the fertility of land—and rock-salt, capable of so many useful applications in husbandry.

The oolitic system, which comprises the lias, oolite, and wealden groups, brings us a step nearer to the existing state of things. It comprehends a great variety of different substances, such as argillaceous limestones, limestones of an oolitic texture, or consisting of an aggregation of small rounded particles, calcareous sandstones, grits, composed of triturated shells and corals, clays, and certain kinds of coal. This is an important and largely developed system in England. Some of the members of it likewise exist in Scotland, but on a very limited scale. The organic remains are

very numerous, and they are dug out in quantities for the purpose of being converted into manure.

The chalk or cretaceous system is one of the most distinctly marked of the whole series. Greensand constitutes the lower part of it, and the highest part consists of the upper chalk, which is soft and white, with numerous thin layers of flint nodules; and the lower chalk, which is harder, and generally has few flints. Chalk is nearly a pure carbonate of lime, and the flint nodules are almost entirely silica, with a slight and variable proportion of potash, lime, and alumina. Extensively developed in England, this system does not now exist in Scotland, although there is reason to believe that it may have once done so to a slight extent.

What is called the Tertiary system includes a great variety of regular strata and sedimentary acccumulations superior to the chalk, and they are arranged into four groups, according to the amount of fossil species they contain identical with the existing species. These groups are named eocene, miocene, pliocene, and pleistocene—the first cotemporary with the dawn of plants and animals now existing, which continue to increase in number in the two intermediate periods, till, in the last, the pleistocene, nearly the whole of the organic remains can be traced to species now living. They are composed of a great variety of substances, deposited under various conditions—sometimes entirely marine, at other times from fresh water, and occasionally from a mixture of both. Their most remarkable feature is the vast number and varied character of the fossil animals found in them, particularly massive and large-boned mammals, now feebly represented by elephants, tapirs, sloths, &c. So varied and heterogeneous are the deposits, that it would lead us too far from our immediate object to describe them at length in this place. Recourse must be had to works strictly geological. Few of the members of this series are much developed in Scotland, with the exception of the Boulder or Drift formation, which is regarded as the uppermost. As that has exercised an important influence on the surface of the country, and has consequently been a powerful agent in modifying its soil and agricultural capabilities, it will demand further consideration afterwards, when we speak of those superficial accumulations which have so often masked the stratified rocks, and buried them to a depth which prevents them having influence on the surface. The same course will be followed with the other superficial accumulations (or Post-tertiary system), which have originated from a variety of causes, and many of which are now going on around us, producing the same effect.

Having thus endeavoured to convey a general notion of the different kinds of rocks, and of their position relatively to each other in the crust of the earth, and also of their composition, it remains for us to say a few words regarding their geographical

distribution. Of this, however, our space will enable us to sketch only the general outline of Scotland, in which the readers of this work are more directly interested. For the details, as well as for the geological features of the other parts of the kingdom, reference must be made to maps, and the works which expressly treat of them.*

The older geologists, such as the late Professor Jameson, were accustomed to consider Scotland under three great divisions, each of them characterised by the prevalence of certain rock-formations. Although such a division does not altogether conform to modern classifications, it by no means does such violence to them as to induce us to forego the convenience arising from it. The nature of the formations, while in themselves presenting features of marked distinction, occasions corresponding dissimilarities in other matters depending more or less upon them—such as the aspect of the scenery, the occupations of the inhabitants, and consequently also, in some degree, their manners and habits.

The southern division extends from the English border northwards to an ideal line running in a north-east direction, nearly from Girvan in Ayrshire to the neighbourhood of Dunbar in Haddingtonshire. The second or central division extends from the line just mentioned to another running nearly parallel to it, from the mouth of the Firth of Clyde, by Callander, Dunkeld, and Fordoun, to the neighbourhood of Stonehaven in Kincardineshire. All the rest of Scotland to the north of this, including the islands, constitutes the third division.

The southern division is most homogeneous in structure. It is mainly composed of a broad belt of the lower silurian or greywacke formation—so partially obtruded on by other rocks, that, in a general view, its continuity seems little interrupted. Kelso stands on a limited area of the undermost beds of the coal-formation, an advanced portion of the great English coal-field south of the Border. To the west of this there is a pretty extensive circular area of the old red sandstone,

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* We believe that it was originally intended that a geological survey of the country should accompany the trigonometrical survey now in progress. This design, however, was speedily abandoned; but a geological survey is now proceeding under the general direction of Sir Roderick I. Murchison, assisted by Professor Ramsay and other men of science, the expense, at least in part if not wholly, defrayed by the Government. Under such auspices we may expect a series of maps which will supersede all others, and prove worthy of occupying a place by the side of those of the topographical survey. Meanwhile the general maps of Professor Phillips, Knipe's map of England, M'Culloch's and Professor Nicol's of Scotland, may be consulted. We have had constructed, on a large scale, a very good general map of Scotland, from the county maps published in the *Transactions of the Highland and Agricultural Society of Scotland*—the parts wanting supplied from other sources. The defect of all existing geological maps, for agricultural purposes, is the absence of correct information regarding the Northern Drift and superficial accumulations, which often exercise a much greater influence on the character of the soil than the fixed rock-formations.

surrounding Jedburgh and Greenlaw, and extending up the Teviot to a little distance beyond Minto. Red sandstone again appears in Dumfriesshire, skirting the shores of the Solway Firth, and surrounding the towns of Dumfries, Lochmaben, and Moffat. West from this the silurian rocks are almost uninterrupted, save by the three great granitic areas of Kirkcudbrightshire, the most considerable of which has the Criffel for its nucleus. These granitic or sienitic masses appear to be of much later formation than the rocks of the same name in the northern division of the kingdom. In Liddesdale the coal-formation again enters this division, with its accompanying limestones. The mountains are seldom of great elevation, rarely reaching 2000 feet, and they are composed either of the nearly vertical silurian strata, or of a dark augitic greenstone. The other igneous rocks are porphyry, the only considerable area of which is formed by the Cheviots, while insulated hills occur here and there, as the Eildons, several hills round Innerleithen, and in the south of Kirkcudbrightshire. This used to be called a transition district, but as that term is now excluded from modern geology, it may be termed the Silurian division. Although so extensively developed in this quarter, it is important to remark that the silurian rocks are almost confined to this part of Scotland, those approaching nearest to them in lithological character found elsewhere, differing in some respects from them, and apparently not belonging to the same geological era. The superficial extent of this division is nearly 5100 square miles.

The second or central division is called a Secondary district, because mainly composed of rock-formations of that class. By far the most important and characteristic of its deposits is the coal-formation, which covers a great part of its surface, especially towards the centre. This everywhere includes immense deposits of sandstone, shales, ironstone, and other substances; and limestones are frequently associated with them. The formations, especially towards the north of this division, show a tendency to run in parallel bands, trending in a north-east direction. Thus, immediately to the north of the coal-field, there is a slightly interrupted and irregular band from Renfrew to the mouth of the Tay, of trappean and porphyritic rocks; this marks the northern limit of the coal-fields in Scotland. This, again, is bounded on its northern side by a broad parallel band of red sandstone, traversing the whole breadth of the country without interruption, its greatest breadth on the eastern coast from Stonehaven southward to the mouth of the Eden, and its narrowest on the west, from Helensburgh to the vicinity of Dumbarton, where it meets the Clyde. Its course can still be traced further in the same general direction, as it reappears in Renfrewshire, Bute, Arran, and touches the south-eastern extremity of Cantire. The great central basin of the Forth and Clyde has a similar boundary of red sandstone on the south side,

crossing the country in the same direction; but it is very irregular, and often interrupted by the intrusion of other formations, particularly of the coal-fields, and the extensive porphyritic range of which the Pentland Hills form a part. Unstratified rocks of different kinds are extensively developed over the greater part of this division, consisting of greenstone, basalt, clinkstone, tufa, and felspathic porphyries. It is the smallest division, its area not exceeding 5000 square miles.

The geological structure and physical features of this section, evidently destine it to be the main seat of the manufactures and commerce of the country, and consequently the place of concentration for its people. Traversed, at almost equal distances, by three great rivers, whose broad and lengthened estuaries carry navigation, from two opposite oceans, far into the heart of the country: abounding in coal, limestone, ironstone, and the finest building-stone, it presents materials to commercial enterprise, and industrial energy, unparalleled for value and variety in any other part of the kingdom of equal extent. It has been calculated to contain nine-tenths of the mineral wealth of the whole kingdom. These natural advantages have been conferred on a people capable of turning them to the best possible account; and the resulting opulence and prosperity, both in their present state, and still more in their future promise, are such as cannot be contemplated without wonder.

The third geological division includes the whole country to the north of this. It is strictly a primitive country, granite and the schistose rocks formed from it occupying nearly the whole surface. Along with the more northern latitude, elevated mountain-chains, naked precipitous rocks, and extensive ranges of wild boggy heath, combine to give it a character of sternness and desolation, which contrasts with the richer but comparatively tame scenery of the central district, and the pastoral softness and repose of that farther to the south. "Its mountain-chains seem to preclude all further progress, and it is only by following some of those rivers which break through the rocky barrier that access to the wild recesses can be obtained. There, lofty mountains covered by naked rocks or brown heath, frowning precipices unsoftened by the hand of time; narrow glens, where the river foams through its rugged bed worn in the solid rock; wide straths, where the torrent slumbers for a while in some deep dark lake, and bleak moors, only diversified by the moss-grey stones or solitary tarn, form the leading features of the scene. Here man and his labours seem like intruders on the solitude of nature." * By far the most extensive rock-formation of the Highlands—and it is confined to the Highlands and Western Islands—is gneiss, which occupies the principal part of the

* Professor NICOL'S *Guide to the Geology of Scotland.*

counties of Inverness, Ross, and Sutherland, and is extensively developed in Aberdeenshire. Lewis, Harris, and the two Uists, are almost entirely composed of gneiss. It is calculated to cover an area of not less than 9600 miles. The chief mica-slate district may be said to commence in the Mull of Cantire, expanding when it reaches the mainland to Loch Etive on the north and Dunoon on the south, whence it follows the general direction so often referred to, embracing a great part of Argyllshire, part of Dumbarton and Stirling, suddenly contracting at Glen Prosen, whence it is continued in a narrow stripe to the east coast. There is a large area on the south-east of Loch Linnhe and Loch Lochy; another in Banff; and it again appears, in some extent, in the west of Sutherlandshire. It is calculated to cover a surface of 3250 square miles. Immediately to the south of this deposit, and lying between it and the broad red sandstone district formerly spoken of, there is a very remarkable belt of clay-slate, intersecting the country from one shore to the other in one continuous zone, its breadth, which is not great, being very uniform throughout. The other chief deposit of clay-slate, which altogether does not occupy more than 650 square miles in this northern division, is in Banffshire. The country lying between the belt of clay-slate and the chain of lochs occupying the depression now traversed by the Caledonian Canal, including a great part of Inverness, the whole of Aberdeen, Moray, Nairn, and Banff, is the chief seat of the granite rocks: they are most developed in Aberdeenshire, where they form the fundamental rock, probably prevailing throughout the whole extent of the county, though frequently overlaid by other formations, and appearing in the lower parts of the county only where the superincumbent deposits have been removed by some denudating agent, such as currents of water, or the action of glaciers. Beyond the limits of the granitic region indicated, considerable areas lie along the north-west side of the Caledonian Canal, and others in the east of Sutherland. Altogether, the granitic rocks are calculated to extend to a superficies of 1760 square miles, including those of Kirkcudbrightshire, which do not exceed 160 square miles. The old red sandstone is extensively developed in the northern division of Scotland, covering an area of not less than 2400 square miles. The whole country lying around Cromarty Firth, the coasts of the Moray Firth eastward to a point beyond the Spey, the east coast of Ross and Sutherland, and nearly the whole of Caithness-shire, are of this rock; it is continued in the Orkney Islands, and large districts occur on the west side of Sutherlandshire. Quartz rock also enters largely into the geological constitution of the northern Highlands. The principal deposit exemplifies that tendency to parallelism which has been before spoken of, a large longitudinal area of it running from Castletown of Braemar in a south-western direction, disappearing in Glenorchy; but following

with the eye the same general direction over the space where it is interrupted, we again meet with it in Jura and Islay, composing, in fact, the greater part of these islands. Skye and Mull are composed chiefly of trap, and fine displays of columnar basalt are frequent among the Western Islands. A pretty extensive formation of serpentine occurs at Portsoy in Banffshire, and fine crystalline limestone, or marble, is by no means rare in Sutherlandshire, and some other northern localities. In this very general sketch of the distribution of Scottish rocks, we can only further mention that the oolitic formation, one so characteristic of the south of England, just makes its appearance in Scotland, always, however, in the northern division. A narrow patch of it skirts the eastern coast of Sutherland from Golspie to beyond Helmsdale; similar patches occur on the east coast to the north and south of Cromarty Firth; others in the Isle of Skye, and a few other localities. The island of Mull has recently attracted attention for its leaf-beds, apparently of the Tertiary period.

Having thus noticed the distributions of rock-formation in Scotland as far as our limits permit, we shall next direct attention to the character of the soil formed from the principal kinds of them separately, before adverting to the many causes which combine to mingle the produce of different rocks, and impart to the soil produced from them that composite character which it is, for the most part, found to possess.

The precedence in this inquiry may be given to granite, as it has influenced the character of so many other rocks, and, by imparting to them similar ingredients, has prepared them to produce similar effects. Of course, it is only simple rocks, or those which are composed of only one ingredient—such as quartz or marble—that produce a homogeneous and unmixed soil. But the majority of rocks contain several different substances, and they form of themselves a compound mineral soil, even without taking into account the substances derived from other quarters, which tend still farther to complicate their character. Of this nature is granite, the composition of which, both mechanical and chemical, has been already noticed. The ingredients vary much in different granites in their relative proportions, and also in their tendency to decomposition, both of which circumstances have an influence on the soil produced from them. We have already alluded to the rapidity with which the felspar sometimes decomposes; in all cases it is the first to give way, because the silicates of potash or of soda are decomposed by the carbonic acid of the atmosphere, which combines with them, and forms carbonates. The latter being very soluble in water, are speedily washed away by rains; while the insoluble silica, the silicate of alumina, and the particles of quartz and mica of the other component ingredients, are either, from their greater weight, left behind, or carried slowly downwards to the

valleys by heavy showers. It thus happens, as has been well remarked by Professor Johnston,* that, on mountain-sides and sloping grounds, the most fertilising parts of the granitic soil are generally carried off, and little remains but an unproductive sand; while, on the other hand, the clay accumulated in the valleys—chiefly the silicate of alumina, owing to the comparative rarity of the silicious sand—is too stiff and intractable to be readily converted into a prolific soil. Mica resists decomposition for a considerable time, owing to the small quantity of alkaline constituents it contains; gradually, however, the potash and magnesia become soluble, and it is converted into clay. In its ordinary state, therefore, granite is of itself deficient in many of the best fertilising elements; but there is a common variety named syenite, in which the mica is wanting, and its place supplied by *hornblende*, which brings considerable supplies of lime and magnesia,† rendering the soils produced from it of much greater agricultural value. The schists formed from granite—namely, gneiss and mica-slate, consisting, as has been seen, of the same ingredients, only in a different state of mechanical aggregation—produce soil essentially of similar qualities. In these, however, the mica predominates, while in the former the felspar, the most valuable constituent, is present in smaller quantities, and in the latter it is entirely wanting. Owing to this circumstance their produce is somewhat inferior in value to that of granite, although, from the greater degree of comminution in the particles, they are more easily decomposed and reducible to soil, a circumstance which may tend so far to counterbalance the disadvantages referred to. Of granitic soils, however, the micaceous, the produce of mica-slate, is regarded as the poorest; and as it and gneiss prevail over such extensive districts, where they form the only fixed rocks, they can derive for the most part but little advantage from the intermixture of other materials. In the mica-slates of Perth and Inverness there is one circumstance which may tend greatly to increase their fertility, namely, the dissemination in the rock of an immense number of garnets—so numerous, that in many cases they may be regarded rather as integral constituents than as accidentally present. Although very variable in chemical constitution, these minerals in all cases contain a considerable quantity of lime—from 21.79 to 37.15 per cent‡—enough to influence materially their effect on vegetation.

The more elevated and thin granitic soils are said to be well

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* JOHNSTON'S *Agricultural Chemistry and Geology*, 2d edit., p. 489.

	Silica.	Magnesia.	Lime.	
†	60.10 —	24.31 —	12.73.—	BONSDORFF.
	59.75 —	21.10 —	14.25.—	Do.

	Silica.	Alumina.	Lime.	
‡	36.86 —	24.19 —	37.15.—	CROFT.

fitted for the growth of the larch.* Judging from what is seen in the Highlands of Scotland, firs and pines generally suited to the climate seem to prosper in granitic soils. Their chemical deficiencies for agricultural purposes are very obvious, but the means of supplying them to a certain extent are equally so. The mixture of crushed or broken mica-slate with a stiff tenaceous clay soil could scarcely fail to have a good effect on its mechanical texture, as it has a greater tendency than even sharp or quartzose sand to render it friable and easily pulverised.

The productiveness of granitic soils, as indeed of every other, must necessarily depend in a great degree on the climate. Thus the fertility of the granitic districts of Cornwall, where the elevation happens to be similar, may be expected to be much greater than those of Aberdeen or Sutherlandshire. But there is one circumstance which removes them, in a much greater degree than the soils of most other formations, from beneficial climatic influences, and which accounts so far for the idea of sterility which we are accustomed to associate with them Granite generally forms the nucleus of our great mountain-ranges; its schists envelop their flanks, and often rise to their highest elevations: they thus unite in forming an alpine or sub-alpine country, which lifts them into the region of cold and storms, where any fertilising properties they possess are never properly developed; while in the intermediate spaces, comparatively flat, but still elevated, water accumulates from the want of natural drainage; and extensive bogs are formed, spreading far and wide the cheerless aspect of infertility and desolation, beyond what the intrinsic properties of these rocks would lead us to anticipate.

The relations which granite bears to the primary schists, may be regarded as somewhat analogous to those borne by the trap rocks to the silurian and secondary formations. The latter are penetrated and upheaved by the igneous masses which have frequently overrun their surface, and mingle their disintegrated materials with theirs. Like the granites, they form mountain-chains, and, in whole or in part, insulated mountains; but they are of inferior elevation and less inhospitable aspect, as may be seen by comparing those of the central and southern divisions with those of the northern. As the most common and important of these, greenstone may be regarded as a type. The composition

* The larch is said by Sir James Stuart Menteath to grow naturally on the primitive mountains, as the granite and gneiss of the Alps; and it is a curious confirmation of this to observe, that in the whole range of the Jura mountains, which is a limestone formation rising to an elevation of several thousand feet, not a single self-sown larch can be discovered. The larches of Dunkeld, which have become celebrated for their size and beauty, are within the limits of the mica-slate region; but we are unable to say how far the micaceous soil may be modified by superficial accumulations.

varies a good deal, but the chief ingredients are augite,* hornblende, and felspar. Albite,† also, is a frequent constituent of greenstone, especially of those kinds which are so abundant near Edinburgh and other parts of the central district. In those of the southern district, which are darker and more compact, augite largely predominates. Basalt is the most compact and heaviest of the trap rocks, of a dark colour and very fine grain, essentially augitic, containing also magnetic oxide of iron—very frequently small crystals of olivine and zeolite. The predominating earth in olivine is magnesia, and the zeolites contain from 10 to 14 per cent of soda, always with a trace, and sometimes with several per cent, of potash. It will at once be perceived, from the chemical composition of these rocks, that they abound in fertilising substances, and constitute, in fact, our most valuable soils. All of them contain lime in considerable quantities; they furnish plants with alkalies and the necessary quantity of magnesia; and it is asserted by Dr Anderson that basaltic rocks contain appreciable quantities of phosphoric acid, so that they are in a condition to furnish the plant with almost all its necessary ingredients. According to Professor Johnston, the quantity of lime in trap rocks is often equal to about 20 per cent of the weight of the rock, or 5 tons of trap contain as much lime as 1 ton of pure limestone. Their value, however, varies very much in different localities, both owing to the modifications to which they are liable in their composition, and the kind of minerals they happen to have disseminated through them, or occurring in veins and drusy cavities. Thus in the island of Skye, which is formed almost entirely of trap, the rock is a variety of augite, named hypersthene,‡ which is so hard as to decompose very slowly, and contains very little either of lime or alumina; hence an unfruitful soil. Trap soils are of a dark colour, especially that formed from basalt. The latter, between the fingers, has a somewhat greasy feel.

The above constitute the chief augitic species of trap; the other division has been named the felspathic, because felspar predominates in their composition. To the latter may be referred the greater part of the porphyries, which form an important feature in the geology of this country. They consist of a basis of felspar, with crystals of different kinds, and, in greater or less numbers, disseminated through the mass. The general characters of the

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	Silica.	Lime.	Magnesia.	Prot. of iron.	Prot. of mang.	Alumina.	
*	54.15	24.74	18.22	2.51	0.18	0.20.	—WACKENRODER.

		Alumina.	Soda.	Lime.	
†	68.46	19.30	9.12	0.63.	—ROSE.

	Silica.	Alumina.	Magnesia.	Lime.	Iron protox.	
‡	54.25	2.25	14.00	1.50	24.50.	—KLAPROTH.

soil may be inferred from what has been already stated regarding the properties of felspar. Alumina, potash, lime, and magnesia, are generally present, although the two latter are in small quantity. The soil formed by its disintegration is apt to be too stiff and tenacious, unless its texture be altered by the intermixture of other substances, and it is commonly of a reddish-brown colour. In the mountainous district of the Cheviots, the rocks, essentially felspathic, are mixed with a great variety of other substances, such as jasper and agates, in all their varieties. They become loose and cavernous, and seem to be continually crumbling down as if rotten. The consequence is that these hills are covered with a good layer of soil, sufficiently friable from the abundant intermixture of silicious particles, and naturally somewhat dry—properties which adapt it well for the support of the fine and nutritious natural herbage which has rendered these hills so celebrated as a sheep-walk. Trap tufa, another form of eruptive rock, which either forms hills of itself or is associated with other rocks in forming them, has an earthy basis, in which are enclosed masses, usually rounded, of other eruptive rocks, or of stratified formations. Its heterogeneous contents must render the soil equally so. The earthy matter, when exposed to the air, soon crumbles down; hence hills formed of this substance have usually a rounded and pretty uniform outline, and are covered with a good deal of soil, not, however, of great fertility.

Besides these there are several other kinds of trap, which may be considered as varieties of the above; but they are by no means of general occurrence, and can have only a partial and local influence on the soil. Although performing a part similar to the granites in the structure of the earth, the trap rocks are thus seen to be vastly more favourable to the interests of agriculture. Their varied and often picturesque forms, while they agreeably diversify the scenery, give rise to many undulating uplands and sloping banks, well fitted to receive the genial influence of the sun; and wherever they are too steep or rugged to admit of the operations of the plough, they never fail to prove valuable pasture-lands. They form the substratum over extensive districts, readily admitting of arable culture, when their fertilising properties are seen to the best advantage. As these rocks are almost always full of rents and fissures, the water from the superincumbent soil finds ready means of escape, and this adds to their other advantages the important one of being generally free from superfluous moisture.

The stratified or sedimentary rocks produce soils of very varied character, the chief properties of which may be inferred from their composition, which has been already described. The silurian rocks, composed of clay and particles of quartz, and very generally interstratified with transition clay-slate, produce by their joint decom-

position a clayey soil of a grey colour, cold, thin, and rather unproductive. The transition clay-slates,* however, contain lime, frequently also magnesia and potash, although for the most part in small quantities: when the lime amounts to 7 per cent, which is sometimes the case, it must have a considerable influence on their productiveness. In the southern division of Scotland, greywacke soil, even when unaltered by superficial accumulations, produces, under the ordinary process of culture, good crops of turnips and oats. On the banks of rivers and in low-lying districts it is always modified and improved by the accession of transported materials. As this rock often forms elevated districts of country, and even mountain-ranges, it is there exposed to a damp and cold climate; but even in these circumstances its soil, when somewhat dry, produces a thick sward of good natural grass, which forms excellent sheep-pasture. The greywacke is almost always pervaded by numerous veins of calc-spar, frequently forming a kind of network, and sometimes several inches in thickness. The soil must derive a great supply of lime from this source, as that mineral contains upwards of 50 per cent of lime. Like the trap-rocks, this deposit contains numerous fissures, which must promote the natural drainage; and as the strata are almost always inclined at a high angle, or vertical, other openings occur between the layers, which will act in a similar way. Through the latter, according to Professor Johnston, the soluble parts of the soil and of the manure are liable to be carried by the rains, thus impoverishing the land.

The soil on the surface of the old red sandstone will vary according to the part of the formation that happens to be uppermost. The conglomerate is composed of an immense number of waterworn pebbles, of various dimensions, and belonging to most of the older sedimentary rocks, as well as some of the igneous ones: the cementing medium, which is the first to become disintegrated, forms a clayey soil. The pebbles, or enclosed rounded fragments, being composed chiefly of quartz, long resist decomposition, and are often found scattered about the country after the decay of the substance in which they were imbedded sets them free. The sandstones, occupying the upper parts of the formation, produce a light sharp soil, and of itself far from productive. The soft red crumbling matter, intermixed with marly beds equally soft and friable, is the most productive. "It yields a warm and rich soil, such as the mellow lands of Herefordshire, and the best in Brecknock and Pembroke shires. The soil in every district varies according as the partings of the marl are more or less numerous. These easily crumble, and where they abound, form a rich stiff wheat soil, like that of East Lothian and parts of Berwickshire; where they are

	Silica.		Alumina.		Iron Protox.		Lime.		Magnesia.		Potash.
*	60.03	—	14.91	—	8.94	—	2.08	—	4.22	—	3.87

less frequent the soil is lighter, and produces excellent turnips and barley. Where the subsoil is porous, this land is peculiarly favourable to the growth of fruit trees. The apple and the pear are largely grown in Hereford and the neighbouring counties, long celebrated for the cider and perry they produce."* The cornstone group, belonging to this formation, often produces a favourable effect on its soils, the disintegration of the calcareous nodules, and the mixture of their ingredients with the argillaceous and silicious particles, forming an excellent compound. Some of the best turnip and wheat lands in Roxburghshire are found in the region of the old red, but in many cases they are mixed with transported matter. The tile-stones are largely developed both in the central and northern divisions of Scotland, in Ayr and Lanark shires, also in Perthshire, the east of Ross-shire, and in Caithness. In most of these districts some of the best corn-lands in the country occur, particularly in the valleys and by the sides of rivers; but in such situations, it is probable that only a portion of the soil is derived from the old-red-sandstone rocks.

The sandstones of the coal-formation are similar in composition to those of the harder and more compact beds of the old red; they consist almost entirely of particles of quartz, and are therefore of themselves unproductive. If in somewhat elevated and exposed situations, they are frequently occupied by barren heaths. The shales produce a stiff unproductive clay; but when mixed, as they often are, with the sharp quartzose sand, they become friable, and may easily be rendered fruitful, particularly by the application of lime. The fine clay of this formation consists of felspar thoroughly decomposed, little being left but the silica and alumina; but when the decomposition has not proceeded so far, Dr Anderson states that different sorts of clay-slates and shales are produced, which, though of considerable hardness, disintegrate sometimes with great rapidity, and often produce soils of much value. The rich soils which are sometimes observed on the lower strata of this formation, as in the vicinity of Kelso, are mainly derived from other sources—alluvial and transported detritus, with contributions from the shales and calcareous beds which are frequent in such situations.

The consideration of the soils derived from the other formations must be reserved for a future occasion, as well as of those alluvial and superficial accumulations arising from various causes, which in so many instances completely obliterate the influence of the subjacent strata on the soil, and introduce new soil-producing substances with which they have no connection.

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* Johnston's *Lectures on Agricultural Chemistry and Geology*, p. 475.

THE FARMERS' NOTE-BOOK.—NO. LIV.

A Walk and a Talk through the Agricultural Implement Department of the Crystal Palace, Sydenham (continued from page 526).—Next to Clayton's machines, Messrs Holmes & Son of Norwich, and Messrs Reeves of Bratton, Wilts, exhibit a variety of drills. At the termination of same side are a variety of bee-hives, exhibited by Marriott of Gracechurch Street, and Neighbour, High Holborn, and a series of exceedingly elegant wire flower-baskets by Richards, 370 Oxford Street, and some beautiful cast-iron garden-seats and terra-cotta garden vases by T. Johnson of Leicester.

The central compartment, 9-10-11-12, is filled with a miscellaneous assortment of machines and implements by various manufacturers, of which we noted the following:—Fowler's patent draining-plough. This mechanism, with the mode of working of which the majority of our readers are doubtless well acquainted, is an accomplished fact. "In clay subsoils," says Mr Pusey, "with a gentle fall, the success of this new implement seems to be beyond a doubt; and in all circumstances the inventor is ready to undertake the risk of the execution." Since the period Mr Pusey reported on it, many improvements have been effected. Instead of the power of horses working the capstan, a stationary engine is used, and wire-rope is employed, on which the drain-tiles are strung. Mr Hoskyns speaks with interest of it, "with its happy incidental adoption of the lately invented wire-rope, and that most suggestive and satisfactory feature which it embodies in its stationary engine. It is impossible to see this . . . without recognising in it the outline of something which may relieve our clay soils as much from the pressure of heavy hoofs and wheels on the surface in the act of cultivation, as his iron-string necklace of pipes relieves their moisture from below, cutting through the subsoil like a cheese." A short notice of the mode of working the "plough" may be of interest to some of our readers. The aperture in which the drain-tubes are placed is made by a pointed "mole" attached to a thin "coulter" or plate, which advances edgeways through the soil; this coulter being attached to the "plough," which runs along the surface of the ground, and is pulled along by a rope attached to the stationary engine or horse capstan. To the end of the "mole" a rope is attached, on which are strung, one after another, the drain-tubes. To commence the "hole," trenches or pits of 4 feet long and 1 wide or so are dug, with one end—opposite to the direction in which the plough is to go—sloping, to admit of the easy dragging down of the rope with its tubes to the level of the bottom of the trench, which regulates the depth at which the drains are to be placed. The "mole" and "coulter" are then lowered into the trench, and the former, entering the soil, is pulled

forcibly along, and, displacing it, makes a passage in which the string of tubes is deposited one after the other. The only evidence above ground of the operation going on below, is the narrow slit made by the passage of the coulter through the soil. On the mole reaching the second trench—a number of these being made in the line of drain, according to the nature of the soil—the rope is withdrawn from the interior of the drain-tubes, leaving them in the soil. A second string of tubes is then attached to the mole, which enters the side of the second trench, and so proceeds.

In the same compartment a variety of "root-graters" are exhibited by Wood of Stowmarket, Barnard & Bishop, Norwich, and D. Fowler and Fry of Bristol, with "seed-drills" and turnip-cutters—an excellent specimen of the latter being exhibited by Samuelson of Banbury. Gilbert, of the Baker Street Bazaar, exhibits patent portable iron hurdles and fencing, to which an ingenious and simple mechanism, containing support and a wheel, is easily attached, by which the hurdles can be moved to the desired spot with great facility. Messrs Hill & Smith, of Brierley Hill Iron-Works, Staffordshire, exhibit a variety of hurdles, fencing, skim-ploughs, &c. Near these we meet with Messrs Barrett, Exall, & Andrews' collection, amongst which we noticed their patent horse-gear and portable thrashing-machine—an exceedingly compact arrangement—their hay-tedding machine, horse-rake, and safety chaff-cutter. Their horse-rake is furnished with a movable clearer, which, by a downward action simultaneous with that which raises the teeth, causes the collected material to be discharged with great ease. We next meet with examples of Coleman's patent harrow-scarifier, subsoil-plough, and cultivator; Bennall's well-known broad share-plough. W. Sawney of Beverley exhibits here specimens of corn-winnowing machines, and Denton of Grantham a double-blast dressing-machine. The well-known firm of Garrett & Co. exhibit, in this compartment, their combined thrashing-machines, oat-crushers, fencing hurdles, &c., &c. At the lower end of this compartment we met with a model of John Henderson Porter's method of constructing timber houses, stables, sheepfolds, &c., of ordinary planks. In this system the upright posts are provided with galvanised iron coverings, which, being put on both sides, and extended each way a little beyond the edges, form grooves in each side. These posts being placed in a line with each other at such distances as may be deemed necessary, the ends of the boards are slipped between the metal grooves: these planks form the side of the buildings; and the joints at the ends are covered by the metal; and there is thus presented, in a neat form, both exteriorly and interiorly, a perfect metal covering to the joints from the roof to the eaves. As will be seen from this description, no nails are used; and the whole can be put up and taken down with great ease, or the

building enlarged or diminished according to circumstances. This alone renders the system well adapted to agricultural buildings of a temporary nature. To make perfect work, the horizontal edges should be ploughed, tongued, and grooved, or the two edges may be crossed by neat-cut strips of felt or zinc.

Having disposed of the great bulk of the implements as ranged in the compartments already noticed, it now remains for us to notice those on side 12-1. And here the first machines which demand a notice are the "centrifugal pumps" of Appold and of Gwynne, which, kept in action, and throwing up huge volumes of water, are well calculated to arrest the attention of the visitor. From the ease with which they are worked, the large per-centage of effective work obtained, the simplicity of arrangement, offering little obstruction to the passage of extraneous matter, and from their being little liable to get out of repair, we are surprised that they have not been more largely employed for the varied purposes of the agriculturist.

Appold's pump, a revolving fan with curved arms, terminating in nearly a tangent to the circumference, works at a high velocity between two casings. The fan is formed of two circular discs of copper, 1 foot in diameter, and placed at a distance of 3 inches from each other. Each disc has a central opening equal to half the diameter, through which the water is admitted; a central plate between the discs serves to give a proper direction to the water, and affords a means of attaching the shaft, which receives motion by a pulley at its outer extremity. The casings or cheeks, between which the fan revolves, serve to protect the outer revolving surfaces, and at the same time to admit of the free influx of the water. A large space is left round the circumference of the fan. As the fan rapidly revolves, the water is drawn in at the centre openings of the fan, and by the centrifugal force sent through the curved passages between the curved arms, and discharged at the orifices at the termination of those in the circumference of the fan.

In Mr Gwynne's pump the arrangement is very similar; there is, however, only one straight revolving arm to the fan. Experiments serve to point to the curved arms as affording the highest per-centage of work. For drainage-works, irrigation, &c., a pump, size B, calculated to raise 500 gallons per minute, takes a power to work it for each foot high of .217 horse-power, the diameter of the suction-pipe being 7, and that of the discharge 6—the price being £33. The centrifugal pump works continuously without the aid of "air-vessels," and there is practically no limit to the height to which water can be raised by it.

Near to these pumps Mr Crosskill has a specimen of his Archimedean root-washer, and his patent self-cleansing "clod-crusher." Next to this is the only specimen of a "reaping-machine" exhibited in the department; it is one of "M'Cormick's," with Burgess

& Key's improvements, the delivery being effected by a series of Archimedean screws, working parallel to one another, and delivering the cut corn at the side of the machine. We now come to three specimens of farm locomotive-engines—the first of which is exhibited by Messrs Hornsby & Son, Grantham, Lincolnshire; the second by Messrs Ransome & Sims of Ipswich; and the third by Messrs Tuxford & Sons, Boston. In the latter, the working parts are all under cover, being in the smoke-box end of the machine. This engine will be recognised as the one which carried off the prize at the Carlisle Meeting.

Next to this engine we noticed a very excellent display of patent harness, exhibited by Dunlop of Haddington. Here also begins the varied collection of implements exhibited by Messrs Ransome & Sims, consisting of ploughs—for which the firm has been long celebrated—grubbers, oil-cake bruisers, bruising-mills, chaff-cutters, harrows, winnowing machines, saw-mill, and portable corn-mill.

At this point we meet with a variety of "churns," amongst which we only discovered two possessing any novelty. The bulk of the specimens were of the "box" species with revolving dashers, the inventors of which have apparently racked their brains to discover modifications of the dasher, leaving untouched the principle of the machine. It is marvellous to notice in this, more perhaps than in any other department, how the changes are rung upon one form, and how seldom attempts are made to elicit a new principle; it apparently being taken for granted that the principle of one established machine is correct, and that all that is required is to introduce modifications of the details to make it perfect. In proceeding to perfect a given machine, it is worth while to inquire whether it would not be better to discover a more economical principle upon which to found a new one. One of the novelties to which we have alluded is a churn introduced by Mr Johnson of Leicester, and termed the "diagonal churn." This is a barrel-churn, which, instead of revolving upon spindles coincident with the axis, is set diagonally, so that the axis of revolution makes an angle with that of the barrel. The result is a differential movement, which produces butter quickly—the manufacturer says in seven minutes. Even this is more the modification of an old rather than the introduction of a thoroughly new principle, although the motion is ingenious, and will doubtless result in a very complete and continuous agitation of the mass. We next come to a compact barley-hummeller by Coombe & Co., and another, an elevator, by Gooch. Pooley & Son also exhibit here a very full display of their well-known weighing-machines, and Messrs Warren of their pumps.

Messrs Smith & Ashby of Stamford exhibit their safety chaff-cutter, to which is attached a side lever, by which the feeder can

reverse the action (even if both hands should be caught in the rollers) by pressing his body against the lever.

Mr Warren Sharman, of Melton-Mowbray, exhibits here his "tubular iron hand-rake," the sides, cross bars, and handle of which are so fitted as to take to pieces at pleasure. We think this adaptation of tubular iron capable of being extended to a variety of implements with great advantage. With lightness and smallness a high per-centage of strength is obtained. Further up the department we see the superior advantages of the tubular system, so far as regards neatness of appearance at least in two "clod crushers," in one of which the shafts are huge clumsy wooden affairs; in the other, light—too light at first sight, the spectator would think—tubular iron. Tested, we have no doubt of the superiority of the latter as regards strength. The principle might be applied to other implements with advantage; indeed, we consider the application of wrought iron in a variety of ways, even to the construction of the framing of implements, as yet in its infancy. Many of our agricultural-implement makers have to take lessons yet from our Manchester engineers, as to the economical uses of malleable iron more especially.

We next came to Patterson's patent compound-action clod-crusher and roller, manufactured by T. Johnson of Leicester. In this there are two rows of discs or rollers, one slightly in advance of the other, and bearing on the ground in two distinct lines: as the peripheries cross and recross each other, a self-cleansing action is obtained. The crushing or pulverising of the soil is also greatly facilitated, for as the discs intersect when they come in contact with the soil, they pound or grind it. A series of cams or eccentrics placed in the cranked or straight axle give each disc a backward and a forward position with regard to its neighbour. The rollers are toothed, and so arranged that it answers the purpose of a roller for wheat and a clod-crusher, so far as these can be united in one implement. While on the subject of clod-crushers, we may point out the peculiarities of another patent, known as Utting's patent regulating roller and clod-crusher. This has two sets of rings, working partially between each other; the peripheries of both sets are not toothed or serrated, one set being flat and the other toothed. The whole are so combined that the plain rings or discs can alone be brought in contact with the land, thus acting as a roller only; or the serrated rings can alone be used, acting as a clod-crusher merely. When used as a combined implement—clod-crusher and roller—the flat rings keep the serrated ones clear, and prevent them from sinking too deeply into the soil. The relative position of the two sets of rings can be adjusted in a very short time, by simply raising or lowering the shafts, and inserting the pins into the proper holes.

Farther up on same side we come to a collection of implements

exhibited by Mr Carson, Warminster, Wilts, amongst which we noticed Moody's turnip-cutter, by which turnips and roots are cut into thin slices for mixing with hay or straw chaff, the clean slices being carried into a basket by the shoot, while the dirt and refuse fall into a separate heap. A "cross-cut wheel roller," a "seven-share scarifier," and a "cheese-press" of a compact and ingenious arrangement, are also exhibited by the same manufacturer. Next to this stand is that of Messrs William Dray & Co., Swan Lane, who exhibit a variety of chaff-cutting machines, winnowing machines, and corn-mills.

Next to this, specimens and models showing the application of the "patent felt" to roofs and rick-coverings are exhibited by M'Neill & Co.; Messrs Grubber & Co. also show specimens of their manufactured felt. Between these we noticed a model of Hayes' elevator, a description of which will be found in No. L. of this Journal, under the article "Additional Notes on the Preserving and Drying of Grain," p. 442. The same manufacturer (Hayes of Elton, near Oundle, Huntingdon) exhibits his "farmer's mill," which is capable of grinding all sorts of grain, chicory, sugar, &c.; it is very compact, well arranged, and is well adapted for the colonies. Next to this is a somewhat striking and rather gaudily painted structure with wirework sides, surmounted at one end by a miniature tower and spire. This is Standing's (of Preston, Lancashire) improved large verandah "poultry-house or aviary, with pigeon-house combined." The poultry-house contains sitting-boxes, separated for the different breeds and classes of birds; also separate laying-boxes, and divisions for chickens with movable perches: the yard attached to the house is 14 feet long by 6 wide. The house itself is lighted by plate-glass, and ventilation is secured by perforated zinc plates and slides; all the appliances, as "fountains" and "feeding-vessels," are ingeniously arranged. To gentlemen and gentlemen-farmers, who wish to have all their departments carried out in complete style, this novel structure, from its compactness and neat appearance, presents many advantages.

In taking a rapid survey of the implements in this as well as in other collections, one is forcibly struck with the truth of the remark thrown out by Mr C. W. Hoskyns, "that, with the exception of the inimitable clod-crusher, almost every mechanical improvement is . . . . . addressed to light-land culture." And looking to the "clays" under superior management, and more efficient mechanical tillage, as the chief if not the only source of increased production of wheat, the grand staple, it is evident that our mechanicians must now direct a large portion of their attention to introducing and perfecting mechanism adapted to this class of soils. We have little fear of our Howards, Tuxfords, Garretts, and Crosskills not being able to effect as great improvements in this department as that of the light-soil mechanism. What they *have* done in this is

sufficient guarantee as to what they *will* do in that. It is evident that we are on the eve of great improvements in the mechanism as well as in the chemistry and physiology of agriculture. And looking at the vast results of what has been done during the last twenty years in the former department alone, we may safely predicate for the art a grand future of increased and increasing importance.

In concluding our brief notice of the Agricultural Department of the Sydenham Crystal Palace, we would thank the authorities for the facilities which they afforded us to examine its valuable and interesting collection of implements and machines. To George Grove, Esq., the Secretary, who afforded us all facilities of ingress, and to Mr C. Garrod, the Superintendent of the Implement Department, who furnished us with a large amount of information, our best thanks are due. R. S. B.

*Page's Text-Books of Geology.** —Of late years almost every branch of Natural History has made remarkable progress. Little more than a quarter of a century ago, it had only a few scattered disciples, working laboriously each in his own favourite department, with very imperfect aid from books; for even when these existed, they were too often inaccessible from their expensive nature. If there was any exception to this, it was in those branches—such as botany—which were required for certain professions; and in such cases they were for the most part studied only in their professional bearings. Nay, scarcely could the student devote his attention to what are called the lower forms of natural objects, without running the risk of being regarded as an imbecile or a trifler; and when he had anything on such subjects to lay before the public, he had usually to accompany it with some apologetical explanation for making them the object of his regard. In the present day, not only have the effects of this ignorance and prejudice happily disappeared, but the tide has set in with an opposite current, and even the obscurest forms of animal and vegetable life have assumed the character of popular studies. Many of them, in their simplest aspects, have found their way even into the nursery; guides to Cryptogams have been provided for the rural wanderer, and Manuals of Marine Zoology, bristling with hard but expressive names, for the loiterer by the sea; and such terms as *Jungermanniaceæ*, *nudibranchiate* and *gasteropod molluscs*, are found in the mouths of those who till lately were unconscious of the very existence of the objects they denote. All this is a movement in the right direction, and it will go on advancing, till we come to the conviction, which should have dawned on us long ago, that natural history must enter as an important

* *Introductory Text-Book of Geology; Advanced Text-Book of Geology, Descriptive and Industrial.* By DAVID PAGE, F.G.S.

element into every system of general education rightly deserving the name.

Geology is one of those branches whose progress has been most rapid. The true aims of the study, and modes of prosecuting it, were long obscured by fanciful theories, either based on a few insulated facts, quite inadequate to admit of wide generalisation, or on views purely imaginary. Speculation has indeed been the bane of geology; with men of genius it has ever been a field for displaying their ingenuity or exercising their fancy; while those who show themselves most ignorant of common things, never seem to have any misgiving as to their ability to explain the formation of a world. No sooner were the observation of facts, and reasoning from them according to the laws of correct induction, substituted for these as the true basis of the science, than it began to advance with a rapidity which has never relaxed. Allied to so many other branches—the mineral, vegetable, and animal—and enlisting in its service so many separate departments of science, it affords a congenial pursuit to almost every one who has entered on the study of any part of natural history. It adapts itself to every variety of capacity or acquirement. The humblest collector of fossil shells or mineral specimens may render useful service; the comparative anatomist, physiologist, chemist, &c., will find ample materials for his investigations; while the exposition of the general laws and phenomena requires the exercise of the highest powers that can be applied to the subject. The relations, also, which it bears, in an industrial point of view, to many trades and occupations, afford other inducements to the study, and have helped to recommend it to general favour.

In these circumstances it is gratifying to find works introductory to the science of such a kind as those indicated above. They give a clear, concise, yet very comprehensive view of the whole subject, in its more elementary relations, and at the same time indicate sources of information which will introduce the reader to the whole of the most valuable literature that exists relating to it. We have seldom, indeed, seen introductory works so well calculated to effect their object, whether we consider the arrangement, precision, and perspicuity of the language, or the style and copiousness of illustration. From the simplest initiatory facts the reader is gradually led onwards to others of a more complicated nature, and thence to the consideration of the laws by which they are governed. The *Introductory* Text-Book is meant to exhibit a general outline of geology intelligible to beginners, and sufficient for those who wish to become acquainted merely with the leading facts of the science; the *Advanced* presents the subject in detail, and is intended for senior pupils, and those who desire to prosecute the study in its principles and deductions. Though thus prepared on the same plan, and the one but an extension or development of the other, they are

both independent elementary works, and may be taken separately or in sequence, according to the progress and purpose of the student. In the main points the reader is brought up to the present state of the science in its nomenclature, palæontology, and arrangement; the subject is considered in an economical and practical view; and an extensive glossary, prepared with much care, explains all the technical terms which can occasion any difficulty. One who peruses these works, or either of them, with care, will be fairly initiated into the leading principles of the science, and prepared to read with intelligence whatever has been written on the subject.

The economical aspects of the subject cannot, in such a work, be treated at great length; but the different provinces in which geology is calculated to be of service are distinctly pointed out, and its uses specified. As one of those branches of science applicable to agriculture, it has been treated of at some length elsewhere in our pages; and as it is chiefly on the same account that the works in question are entitled to notice here, we shall extract what Mr Page says touching the mutual relations of the two subjects, as a specimen of the work. "The assistance which geology is calculated to confer on the science of agriculture, though somewhat overrated at one time, is certainly among the most obvious of its practical features. All fertile soils consist of two classes of ingredients, organic and inorganic; the former derived from the decomposition of vegetable and animal matter, the latter from the disintegration of the subsoil, or of the subjacent rock-masses. Without a certain proportion of organic matter no soil can be fertile, hence the continual application of vegetable and animal manures; but it is equally true that, without a due admixture of inorganic or mineral compounds, all attempts at its permanent improvement will be fruitless. All the mineral elements essential to fertility may not exist in the soil of a particular locality; but the moment that chemical analysis has indicated the deficiency, the farmer can readily obtain the required ingredient from some other district, or it may be from the subsoil of his own fields, and so effect the permanent improvement in question. To do this, however, he requires to know not only the chemical composition of rocks and soils, but the precise spots they occupy; in other words, he must be familiar with the language and delineations of a geological map of his own district, and know the lithological peculiarities of the respective formations. We have already stated that for agricultural purposes two sets of maps are necessary—one exhibiting the nature and area of the superficial accumulations, and another devoted, as usual, to the rock-formations that lie below. Aided by such helps, and sufficiently acquainted with the science to be able to take advantage of their assistance, the geological farmer has a power at his command which he may turn to the best account, either in the permanent improve-

ment of the soil he occupies, or in the choice of a farm for carrying on the operations of some special department of husbandry. Besides the permanent admixture of inorganic substances, there are other conditions necessary to increased fertility—such as facilities for drainage, capability of retaining moisture, the innocuous nature of the subsoil, and the power of absorbing and retaining solar heat. Soil overlying trap and limestone requires less artificial drainage than that covering the coal-measures, the new-red marls, or wealden; because the former rocks are traversed by numerous joints and fissures, which act as so many natural drain-pipes, while the latter are chiefly tenacious and impervious clays. Again, land of itself dry and friable may be rendered wet by springs which arise along some line of dislocation. The farmer acquainted with the deductions of geology would cheaply lead off these springs at their source, while he who is ignorant would laboriously furrow-drain his whole field, and find, after all, that this was the less effectual method of the two. Such are mere indications of the assistance which geology is calculated to confer on agriculture."

*Dickinson's Instructions for Growing Italian Rye-grass.**—The *Lolium Italicum* is not, as some suppose, a variety of some other rye-grass, but a distinct species, differing from the common rye-grass in its florets being awned. It has now been for a long time well known to agriculturists, but it is only of late that its peculiar merits, and singular prolificacy under certain kinds of treatment, have been fully understood. It used to be sown with grain crops, for which it is ill fitted, owing to the rapidity of its growth; and also in grass and clover lands, where it proved a valuable auxiliary. Its real value, however, could not be appreciated till it was sown by itself, to produce green food for soiling, in which it perhaps surpasses all other forage-plants. It is of very rapid growth, attains, under proper culture, to great height and luxuriance, is extremely nutritious, and so sweet and palatable as to be eagerly consumed by horses, cattle, sheep, and pigs. There are a great many varieties of this grass. Mr Lawson states that he received, in 1838, specimens of no fewer than fifty distinct spikes collected in one field. The varieties differ much in value, and great care should be bestowed in the selection by those who wish to grow it. One variety is distinguished by the name of the individual who published the work referred to below; and as he has been eminently successful in cultivating it, we propose to give a short account of his method, which has been followed, in its essential points, by many other agriculturists. We believe that Mr Dickinson has the merit of first introducing this system on his farm of Willesden,

* *Instructions for Growing Italian Rye-Grass.* By WILLIAM DICKINSON. Second Edition. London: James Ridgway. 1856.

not far from London, where it attracted much attention, the produce being so great as to surpass all previous examples. His experience, embodied in the little work before us, is the result of fourteen years' practice.

As urine is the principal agent by which this plant is forced into such extraordinary exuberance of growth, the chief features in Mr Dickinson's plan are the methods of collecting this liquid manure, and distributing it over the crops. Of such high value, it must be collected from every possible source; and not only must none of it be lost, but it must be kept in such a manner that none of its good qualities shall escape. Tanks or reservoirs require to be constructed in the first instance, and the method he adopts of doing this appears both efficient and economical. At some distance from the dwelling-house he has a hole dug 8 feet in diameter, and 14 feet deep, the bottom of which is covered with a deep coating of clay rammed hard down. "The bricklayer then lays his bricks—4-inch work without mortar—just as a well is steyned, round a circle 5 feet in diameter. An old tire of a wheel suspended from the surface answers the purpose well, the space behind the brickwork to be rammed in with clay as before, and the tire raised as the work proceeds. The ramming of the clay must be perfectly done, the clay moist as it is fresh dug, not wetted: upon the performance of this work depends the efficiency of your tanks. Brick and cement will not answer the purpose for urine alone, but they will if the liquid is urine and water. This tank will contain about 1000 gallons. As many as are wanted may be built up adjoining each other, by which they act as filters to each other, and one pump pumps the whole. I had seventeen in one body. They may be covered with a close wooden cover, or contracted in the building towards the top, and closed by a man-hole entrance covered by wood or stone. They will cost, built by country bricklayers, under £3 each, the farmer doing the digging, &c. at the cost of the labourers' hire."

The next part of the process is the construction of the drains by which the liquid is to be conveyed from the stables and byres, &c. to the tanks thus prepared. Each stall for a horse or a bullock has a drain down the centre, beginning 4 feet from the wall at the manger, and reaching to the end of the standing, where it meets one of larger dimensions running across, which forms a general receiver to convey the liquid to the tank. This also answers for mares and cows. The drains are of angle iron, bought ready made at the ironfounder's, at a price little exceeding that of common iron. Those down the stalls are of 2½-inch angle iron, covered with a flat bar of iron just narrow enough to drop into the angle, and has a bearing across each end of it, to keep it in its place. The paving must have a little inclination every way to the drain in the centre. The general cross drain, which

receives the contents of the others, is of 4-inch angle iron, covered like the former, or with a wooden cover. These drains are to be kept clear by being swept every other day, so that there may be no obstacle to the escape of the urine to the tanks.

The land should be prepared for a crop by the usual processes of ploughing, clearing, and pulverising,—the grass seeds, at the rate of 2 bushels per acre, sown each way of your land, two this and two that way across, sown by the broadcast machine, and then lightly bush-harrowed. If there be need for it, the first crop should be hand-weeded, which is all that will be required for the two years during which the plant stands. If the plants appear to be weak at first, they should receive a dressing of 2 cwt. of guano to the acre, mixed with earth or damp ashes, as it is very important to have a large crop the first cutting. The urine may be distributed either by steam-engine through iron pipes under ground, or by water-cart above. An acre will require for one watering about 3500 gallons. One watering produces one crop upon tenacious land; very open light soils may require two.

Urine, which our author regards as the very essence of all manures, varies much in specific gravity in different animals. Water being 1000, that from pigs, which is the lightest, is about 1006; that from sheep next; from cattle, 1015; that from horses and human beings is the heaviest, about 1020 to 1025, according to the quantity of salts they contain, all being influenced by the nature of the food. Collected from various animals without water, urine weighs about 1018; one part of this to two of water will reduce it to 1006, which is the state in which it is best fitted for Italian rye-grass. Urine and water, of the specific gravity of 1006, would be too strong for common grasses, and would entirely destroy clover.

In cases where the supply of urine failed, Mr Dickinson has applied guano—from 2 to 4 cwt. to the acre—in the winter or spring seasons. He has also used nitrate of soda in the summer—2 cwt. to the acre—with great success; and the same quantity, mixed with finely-sifted mortar rubbish, was found to make an admirable dressing.

And now for the results of this process, which we give in Mr Dickinson's own words. "When I have kept the plant entirely for green food, without growing seed or making hay, I have seldom had less than seven crops during the year; and I have had ten, each weighing from 6 to 20 tons to the acre. The same results will follow to others using the same means with the same plant. Grass sown in August will produce a crop, in an ordinary autumn, in November; another in February, or early in March; in six weeks a third, in five weeks a fourth, in three weeks a fifth, in three weeks a sixth. These two last, grown with a high temperature, may be the two largest crops of the year—perhaps a yard high

and thick upon the ground; and the crop becomes lighter as the temperature falls with the approach of winter. Watering the same day as the grass is cut, is the only mode to obtain the largest amount of produce." Sometimes the produce has exceeded what is here stated, amounting in one instance to 25 tons the acre; and in another even surpassing that, the plants being 5 feet 10 inches high; but the crop was borne down by its own weight.

One of the most valuable qualities of this grass is the amount of nitrogen it contains, and hence its excellent feeding properties. The produce of a quarter of an acre (the acre being 6 tons 8 cwt.) was weighed, and sent to Professor Way to analyse, and ascertain the quantity of nitrogen it contained, cut in the green state after the dew was off. It contained about 55 lb. per acre in one crop, equal to 64 bushels of wheat; 30 tons—the preceding years' produce, in five cuttings—contained as much nitrogen as between 200 and 300 bushels of wheat.

Placing all the facts before him, Mr Dickinson makes a calculation of the money-value of the crops thus produced. As the plant is biennial, the calculation extends over two years. The whole expenditure on an acre of good land, including the rent, dressings with guano, and every other item, on a scale approaching to extravagant, he makes amount to £39, 2s. 0d. Confining himself to seven mowings in the year, and taking the moderate average of 10 tons per acre as the largest, and decreasing the calculation to 4 tons, the smallest crop he had ever known, he finds the produce, at 15s. a ton, to be £73, 10s.; thus yielding a profit on 1 acre, for two years, of £34, 8s.

The practice of irrigating with liquid manure after the manner here described, has been introduced into various parts of England, and also of Scotland, especially in Ayrshire and the vicinity of Glasgow. When conducted on a large scale, as it is in some instances, the liquid manure is distributed over the fields by a system of iron pipes, and the pumps are worked by a steam-engine. The cost of the apparatus on Myre Mill farm has been £1586, and the annual working expenses £118, 19s. The most profitable plant for the application of the liquid manure has been found to be Italian rye-grass, of which, a few years ago, 15 Scotch acres were under cultivation, on a dairy farm near Glasgow, with seed supplied by Mr Dickinson. The first cutting of this had yielded about 10 tons the acre, the second 9, and the third estimated at nearly the same. On Myre Mill farm there were lately 70 acres of Italian rye-grass under cultivation, and the "Minutes of Information," issued by the General Board of Health regarding sewage manure, represent the crops as most flourishing:—

One field of rye-grass sown in April had been cut once, fed off twice with sheep, and was ready (20th August) to be fed off again. In another, after yielding four cuttings within the year, each estimated at 9 or 10 tons the

acre, the value of the aftermath for the keep of sheep was stated at 25s. an acre. The exact increase of produce has not been accurately determined, but the number of cattle on the farm has increased very largely, and by means of the Italian rye-grass, at least *four* times as many beasts as before can be kept now on the same extent of land, *the fertility of the land being at the same time increased.* This plant, of all others, appears to receive its nourishment in this form with the greatest gratitude, and to make the most ample returns for it; and great as are the results hitherto obtained, I believe that the maximum of productiveness is not yet reached, and that the present experiment must be carried yet further before we know the full capabilities of this manure. Of one important fact connected with this crop I am assured, that, notwithstanding the rank luxuriance of its growth, animals fed upon it not only are not scoured, but thrive more than on any other kind of grass in cultivation. . . . . Mr Young informed me, that in one of the fields he had himself measured the growth of the Italian rye-grass, and had found it to be 2 inches in twenty-four hours; and that within seven months Mr Kennedy had cut from a field we were passing at the time 70 tons of grass per acre. When the whole is cut, four or five heavy crops are then taken; but upon some of the land, during the last two years, twenty sheep to the acre have been penned in hurdles, and moved about the same field from time to time; after each remove the fluid has been applied, and immediately followed by an abundant growth of food. There is not the slightest appearance of exhaustion in the land; its fertility appears to increase. I was informed that, before the liquid manure was used, the land would not keep more than a bullock or five sheep to the acre; now it will maintain, if the crops are cut and carried in, five bullocks, or twenty sheep, to the acre.

It might have been thought, when Mr Dickinson first obtained his remarkable crops of this grass, it was owing to some peculiar fitness in the soil or climate, the longer season of the south of England, or abundant supply of urine from the London stables. Like results, it thus appears, have been obtained in many parts of Scotland, more especially on the western side of the island; so that, whatever natural obstacles may arise from the absence of the advantage referred to, the singular energy of the manure, in reference to this plant, is able to overcome them. As a suitable soil for its culture, Mr Dickinson prefers clay, or clay upon an open bottom, loam upon gravel, old red sandstone, or black peat drained and limed. The limestones generally should be avoided.

AGRICULTURAL SUMMARY FOR THE QUARTER.

It has often occurred to us that it would be both useful and interesting to agriculturists to condense into a short paper in the Journal an account of the principal events connected with agriculture which may take place during each quarter; to have, in fact, a resumé of the agricultural proceedings of the quarter inserted in the number of the Journal immediately succeeding it. Often have most useful hints and important facts—the embryos of great improvements in agriculture—been overlooked at the time they were first published, simply from their not being brought prominently enough before the public. The slowness of their development was due not so much to their having occurred before their time, as some might suppose, but very often to the form in which they were made public. It is with the hope of assisting in the progress of agriculture that we have ventured to prepare this summary of agricultural news for the last quarter; and in carrying out our purpose now and at a future time, we shall endeavour to select for remark both what may have excited interest at the time, and what, though useful, may not have been sufficiently noticed.

The principal agricultural event during the last quarter was the harvest, which will ever be remembered, by the farmers in the east and north of Scotland, as one of the most disastrous they have had this century. The wet cold summer, accompanied as it was by very little sunshine, augured a late but bulky crop, with deficiency in the quality of the wheat at least. Harvest was general in the lower districts of the east and north of Scotland in the second week of September, though progress in cutting was but slow, owing to the unsettled state of the weather. During the third week, however, when we had dry and windy weather, most of the crop in these districts was in the stook. As yet very little had been led into the stackyard, even in the earliest climates, in consequence of very heavy rains on the 14th, 21st, 23d, and the memorable storm of wind and rain on the 27th and 28th of September, which not only thoroughly soaked the sheaves in the fields, but drowned the stacks which had not been covered, as was the case with most of them. Immediately after the 28th the weather settled down to a dull thick mist, with a considerable rise in the temperature; the consequence of which was extensive sprouting of the wheat and oats, throughout the whole of the country subjected to the storm and the succeeding mist. It is not easy to estimate the amount of damage done by the sprout, which varied in different localities: in low sheltered situations it was very great, while in more elevated and exposed quarters it was comparatively little. This weather having continued for some time, with no wind, and

as little sunshine, the situation of the farmer became one of much anxiety, requiring constant vigilance, patience, and that discrimination and skill in his business, necessary to enable him to decide what would keep in the stack, and what would be better left out in the fields to be still farther exposed to the elements. No one ever recollects seeing so much of the crop exposed in the stooks at one time as was observed this year in the eastern and northern counties.

The cause of the lingering harvest was not so much the quantity of rain which fell, as the want of wind to bring the sheaves into condition. In the districts referred to there was scarcely a sheaf put into the stacks which had not been opened up at least once in the field. The loss from this operation, in the shedding of the grain, was immense, which, added to the great loss from sprouting and discoloration, will cause a considerable deficit in the farmer's accounts this season. It is curious that the south-western counties did not at all experience the storm which did so much damage in the other parts of the country: there the harvest has been one of the shortest and most abundant that has been known for many years. We are not sufficiently versed in meteorology to know whether storms are cyclic; but it is a curious fact that, while the harvests of 1816, 1836, and 1856 were wet, long, and tedious, those of 1826 and 1846 were very early, short, and dry.

Reaping-machines were less used last year than they were some years before. And as generally happens when an unfavourable season occurs, numerous suggestions have been offered to enable the farmer to counteract the bad effects of such season. Amongst those made this year, two deserve notice, viz., the erection of a drying-house for bringing the grain into condition immediately after it is cut, and the erection of a kiln for drying the grain after it is threshed. The idea of having drying-houses erected on the farm is not new, but has been expressed in this Journal before this season. However much we would like to see the operations of the farm made as much as possible independent of the weather, we are afraid that there is no immediate prospect of this idea being carried into execution; for the houses that will be required, first for drying and then for storage, if the heads are cut off and dried, will be much greater than the suggestors of the idea seem to be aware of. And though the operation appears economical and easy enough when described, experience has taught us in too many instances that, when it is reduced to practice, difficulties and expenses occur that were never thought of in the prospective estimates. The same remarks, however, do not apply to the erection of kilns. We think that every arable farm of from 300 to 500 acres ought to have a kiln erected as part of the steading. It is not merely in years such as this that it will be found useful, but every year it would be called into requisition, with great advantage to the farmer in bringing the grain into marketable condition immediately after

harvest. Besides, where stock is kept, the use of grain, cake, &c. in addition to the roots and grass of the farm, is becoming every year more extensive. And as the grains, beans, &c. are found more profitable when first reduced to meal, machines are being attached to the steam-engines for grinding them; and as this cannot be effected for a great part of the year without the grains being first kiln-dried, the erection of a kiln becomes almost a necessity in such cases. There are many other circumstances in which a kiln can be rendered profitable to a farmer which we might mention, but we shall content ourselves by merely stating here that we have never yet known of a kiln being erected on a farm which has not far more than paid the expense of the erection in the course of a year or two.

Agricultural Meetings.—Of these there are two kinds held, viz., those of Farmers' Clubs, at which agricultural subjects are discussed, and those held under the auspices of agricultural societies, comprising a show of stock, a dinner, and speeches thereafter. The last quarter has been distinguished by several of the latter kind, where not a few of the leading members of Parliament have expressed their opinions on important subjects pertaining to agriculture. Released from their parliamentary duties, they employ their idle time by tendering gratuitous advice to their agricultural constituencies and farmers generally. One is very apt to suppose, on reading the speeches of these gentlemen, and of other members of the community, that every one knows more about farming than farmers do themselves. Such wholesale advice is offered to no other body of men; and the sapient advisers are often shocked at the reception which their counsels meet from the ignorant farmers, and the base ingratitude that is evinced by them for the trouble they have been at in enlightening them. One of the most notable of these farmers' friends is Sir James Graham, who generally takes advantage of the parliamentary recess to give some hints, or, as he expresses it, to "read a lecture" to the farmers of Cumberland. Some years ago he told them that they "ploughed too much and grazed too little;" and advocated the cultivation of flax. In neither instance, however, has his advice been followed; nor is it likely to be so, as long as wheat, barley, and oats remain at the present high prices. Insisting, however, on the soundness of his advice in these instances, he volunteers counsel on another point. "I am an advocate," says he, "for the utmost degree of freedom in the conditions of leases. I do not think it wise to hamper tenants in their leases—still I do think that there is too great a tendency to grow potatoes in this country. We have an awful warning: it is a tender plant, it has become an uncertain plant; and we have only to look across the Channel, where, in the course of a few years, no less than two millions of our fellow-creatures have paid the penalty of death or exile for their too great dependence upon

that precarious article. If you grow potatoes, relying upon the railroads for facility of exporting them, you will make the most fertile land perfectly sterile. It is a gambling transaction. If you plant upon good land, the crop is always doubtful, and the loss severe. If it is a good crop, it impoverishes the land to an extent which no ultimate advantage can compensate."

Such is the advice tendered by Sir James, and such are the reasons given by him for offering that advice. And if it is applicable to the agriculture of Cumberland, it is equally so to that of many other districts of England and Scotland; and we therefore think it proper to take notice of it at greater length than we otherwise would have done. We agree with him that tenants should be as little hampered as possible in their leases. We agree with him that a good sound crop of potatoes sold entirely off the farm is one of the most exhausting that can be grown, more so even than the cereals, for, with the exception of the haulms and a few small potatoes, everything is taken off the farm, while the straw of the cereals is generally consumed on the farm. We agree also with him that the cultivation of the potato is attended with great risk. We differ, however, from him in comparing the cultivation of the potato on farms in Cumberland under a regular system of rotation with its cultivation on the small peasant-holdings in Ireland. The disastrous results of over-cultivation felt in the latter case can scarcely ever occur in the former; for as all the straw of the grain crops has to be used on the farm, turnips, or other green crops than the potato, must be cultivated for that purpose; and hence the growth of the latter will be restricted, and the evil consequences of over-cultivation prevented. We differ also from him in supposing that the potato grown for exportation will make "the most fertile land perfectly sterile." We may presume that no sensible farmer growing a crop for exportation would do so unless it proves profitable to him. Now, we maintain that the potato, the cultivation of which is most expensive, would prove unprofitable to the farmer long before it reduced a fertile soil to sterility; for, to be profitable under an ordinary system of farming, it must be liberally treated with manure which will maintain the fertility of the soil. Again, we differ from him in supposing that the "potato impoverishes the land to an extent which no ultimate advantage can compensate." Now, though we consider the potato an exhausting crop, we say that it cannot be profitably raised without a most liberal application of manure, either made on the farm or purchased elsewhere, which will compensate for the exhaustion produced by it. Besides, in some districts a better crop of wheat will be produced after a well-managed potato-crop than after a well-managed bare summer-fallow—an advantage, certainly, which may compensate for any slight loss in the potato crop.

We have often thought that there are far too great restrictions placed on the growing of some crops, and the potato in particular, in these times when there is such an abundance of light manures to aid the farmer in maintaining the fertility of the soil. The over-cultivation of the potato, or any other vegetable, is an evil which will cure itself. The farmer will not continue to raise what he finds to be unprofitable, and he cannot raise the potato profitably without treating it liberally, and thus benefiting his farm. And if the disease cause a loss to him one or two years, we have abundant evidence, from what took place after the disastrous years of 1845, 1846, and 1847, that he will either cease to cultivate, or materially diminish the breadth of his potato crop. But the strongest proof against the soundness of Sir J. Graham's advice to the farmers of Cumberland is, that in those districts where the potato has been most extensively cultivated as part of a regular rotation, the land is in a high state of fertility, and the farming superior—as in Fife, the neighbourhood of Edinburgh and Perth, and at present in East Lothian.

Agricultural Statistics.—Another subject that has been brought prominently before the public at these meetings is that of Agricultural Statistics. From the prominence given to it by all the county members, we are certain that it will be made one of the principal questions on the hustings next election. If so, it would be as well that members would inform themselves better on it than they appear to have done hitherto, if we are to judge from their speeches recently delivered. There is evidently great misapprehension on this subject abroad. We are told by Lord Stanley and others, who are expected to know better, and are generally correct in statistical matters, that agriculture is the only great interest in the kingdom about which there is not correct statistical information. We admit the meagreness of our knowledge on this point in agriculture; but we deny that information of the same kind is any fuller in manufactures and commerce. There is no manufacturer or merchant ever asked to give such a detailed return of the produce of his manufactory or speculations as is required of the farmer for his farm. We regard, therefore, the success which has attended the statistical inquiry in Scotland as most honourable to the Scotch farmers, who have come forward voluntarily to supply, more for the public good than for their own interest, information on their business which could not have been obtained so accurately in any other way. In this they have shown a distinguished example to every other class in the community, and their conduct contrasts most favourably with that of their English brethren. But, considering the circumstances in which the latter are placed, we ought not to judge them too severely; for, being but tenants from year to year, they naturally enough feel reluctant to give a detailed account of the crops on their farms—a pardonable jealousy of what

use might be made of the returns being an excuse for this reluctance. This is a point, strange to say, that has been entirely overlooked by all the English members who have expressed their opinions on the subject. But there is another disadvantage under which the English farmer labours which is not felt by his brethren in Scotland. There is not in England any body representing the interests of agriculture in which the farmer has the same confidence as the Scotch farmer has in the Highland and Agricultural Society, under whose auspices the inquiry has been conducted. We question much that, if the Highland Society had not taken up the subject, there would yet have been any agricultural statistics for Scotland; of which those for 1856, which have recently been published, will be commented on in another place.

Road Reform.—This subject has been very much agitated throughout the country during the last quarter. The altered circumstances in which the roads have been placed by the withdrawal of the traffic from them by railways, and the consequent deficiency of funds necessary for their repair, have forced the consideration of the subject on the trustees, and also given the public an opportunity of expressing their opinions on a system from which many benefits have been derived, but which is found unsuited for present circumstances. We are glad to see the tenants bestirring themselves on this question. It is absurd to say, as some trustees do, that tenants have nothing to do with the present agitation. Has a tenant, who has taken a farm on a nineteen years' lease, two or three years of which only have run, no interest in a system, by the carrying out of which he may be hemmed in by tolls for the remainder of his lease? The great through traffic on the roads being diverted to the railway stations, the trustees, we conceive, are but acting on the principle of the turnpike system in placing toll-bars near railway stations. But while we admit this, we say that now is a favourable opportunity for inquiring into the correctness of that principle, and whether a better plan for raising funds for keeping up the roads cannot be substituted for that of turnpikes. And we therefore rejoice at the opposition offered to the attempts made by trustees to put up new toll-bars in particular districts, as by that opposition time will be given for the thorough investigation of the subject.

Special Manures.—Several cases have been decided in the Scotch courts of late against the venders of some special manures. The agents of the "Economical Manure" have obtained unenviable notoriety in this way. While we are glad to find that the interests of the farmers are so well protected by the laws of the land, we have no sympathy with those of them in the annoyance and loss to which they are put by the use of some of these manures, after the repeated warning they have got against them. No farmer should purchase any of these manures excepting according to

analysis, however high the respectability of the dealer from whom he may purchase them. This is the only check a farmer has against any fraud being committed, and every merchant who values his own reputation should also adopt the practice of selling by analysis; we are glad to find that some have already done this, who are in every way worthy of the support of agriculturists. As all dealers in Peruvian guano are bound to deliver an article containing certain substances in certain proportions, so should the same obligation be required of dealers in every kind of manure. It is worth noting that the "Economical Manure" is never presented for sale according to analysis, while volumes of specious certificates in its favour are showered on the agriculturists throughout the country. And when analyses have been obtained by private individuals, they have never been found to agree in anything excepting in the deficiency of those substances necessary for the growth of plants. We can easily therefore understand how discordant results have been obtained from the use of the manure. These remarks are especially called for at the present time when the rise in the price of guano will induce many farmers to try substitutes for it, the cheapness of which will be a strong recommendation. We can only repeat our advice—Never buy any special manure excepting according to analysis.

The Mixing of Seeds.—An interesting experiment performed in France in mixing different kinds of wheat for seed has lately been published. Fifteen varieties of wheat, amongst which were Hunter's and Fenton, were sown separately, on about 24 poles of land for each, and a sixteenth plot was sown with a mixture composed of all the varieties; this latter plot was the most disadvantageously situated of any, being bordered by elms whose roots stretched into the plots, and which shaded much of the ground from the influence of the sun. It was on this account it was rejected as being unsuitable for the experiment with the varieties singly, and a mixture of the whole was sown, merely that the ground might be occupied. The results were quite unexpected; for while the yield of the most productive variety, viz. blood-red wheat, sown singly, was 26½ bushels per acre, and that of the least productive, viz. a French variety, was only about 12¾ bushels per acre, the produce of the mixture was 29¼ bushels per acre. So in straw the mixture produced about 44½ cwt., while the next highest produce, viz. that of red chaff Dantzic, was 41¾ cwt. per acre. M. Rousseau, the farmer who performed the experiment, explains the prolificness of the mixture from the fact of the different kinds of wheat coming into ear at different times, thus affording more chances for the proper fecundation of the flower, and also for the development of the pickle. He also considers the inequality in the length of the straw of the different varieties an advantage, in preventing the ears being too closely packed; thus allowing the

free admission of air amongst them, and more liberty to expand during the filling of the heads.

The practice of mixing different kinds of wheat for seed is regularly followed in some parts of France, five or six varieties being used for the purpose. The results of such mixtures have always been successful, the produce never being inferior to that of any variety sown alone. The mixing of oats in this country, also, has always been attended with success, both in the yield of grain and of straw. And when, during the time of low prices some years ago, the coarse but prolific varieties of wheat, such as Fenton, were not very readily bought by bakers, some farmers adopted the practice of mixing them with the finer varieties, such as Hunter's, and sowing the mixture. They generally succeeded in obtaining a larger produce than if the wheats had been sown pure; and as good a price was obtained for the mixed produce as for the best variety when sold by itself.

Transmutation of Wild Oats, and Hybridisation of the Swede.—There have lately appeared in the *Agricultural Gazette* accounts of experiments on these interesting subjects, which the editor, Mr Morton, has been conducting for some years. Those with the wild oats were commenced in the autumn of 1851, and have been carried on ever since, the results of which evidently point to the wild oat as the origin of the cultivated variety. There is certainly far more probability of two species of the same genus being derived, the one from the other, than that one genus should be the origin of another genus of plants, as is alleged of the Aegilops and the common wheat, the former being found to produce, by careful cultivation, the latter. His experiments on the hybridisation of the swede have not been carried on for so long a period, and have not yet, consequently, been attended with such decided results; but so far as they have gone, they appear to support the opinion which he has expressed, viz. that the swede is but a hybrid between the common turnip and the wild rapeseed. Both of these experiments possess much interest, both for the scientific and the practical man, as showing the unlimited power we have of multiplying the species and varieties of our cultivated plants.

AVERAGE PRICE OF THE DIFFERENT KINDS OF GRAIN,

PER IMPERIAL QUARTER, SOLD AT THE FOLLOWING PLACES.

LONDON.

Date.	Wheat.		Barley.		Oats.		Rye.		Pease.		Beans.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Sept. 6.	75	11	45	3	26	9	46	5	40	2	35	10
13.	70	3	45	2	22	11	44	0	40	8	35	9
20.	70	6	48	1	26	9	45	0	45	8	41	8
27.	67	8	46	8	23	3	44	4	47	1	44	4
Oct. 4.	69	3	43	7	25	9	41	11	47	10	40	10
11.	67	7	45	10	26	3	42	0	48	1	41	8
18.	72	11	44	8	29	0	43	0	47	10	42	1
25.	70	10	45	2	28	2	42	6	48	5	41	7
Nov. 1.	71	0	46	9	27	10	42	0	47	4	45	8
8.	70	1	46	9	27	9	42	1	48	3	41	1
15.	72	3	47	7	26	10	41	11	41	10	43	6
22.	70	3	44	2	25	7	40	4	46	5	44	3
29.	65	9	43	8	24	6	40	0	48	4	44	9

EDINBURGH.

Date.	Wheat		Barley.		Oats.		Pease.		Beans.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Sept. 3.	73	11	40	7	36	5	47	2	47	7
10.	74	0	48	0	35	4	49	8	51	2
17.	78	2	44	6	34	9	50	6	51	8
24.	75	0	43	7	34	10	50	8	51	6
Oct. 1.	74	5	42	11	35	6	52	6	53	8
8.	72	11	44	7	34	11	55	0	56	1
15.	67	3	42	8	32	1	54	8	55	4
22.	65	2	40	6	29	9	56	2	57	4
29.	68	11	40	7	27	7	55	2	56	4
Nov. 5.	67	4	41	4	28	9	51	6	52	3
12.	63	6	38	11	27	8	53	6	54	4
19.	58	6	41	7	25	6	40	9	42	1
26	57	4	39	2	26	3	40	6	41	4

LIVERPOOL.

Date.	Wheat.		Barley.		Oats.		Rye.		Pease.		Beans.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Sept. 6.	75	3	43	6	26	5	44	2	42	6	48	6
13	67	1	42	8	22	6	43	6	41	9	47	2
20.	64	3	41	7	26	4	42	9	44	6	46	4
27.	62	10	41	2	27	5	41	8	45	8	48	2
Oct. 4.	60	0	41	6	26	3	42	4	46	6	50	9
11.	60	9	43	4	25	10	43	6	47	4	50	10
18.	60	5	43	5	26	0	44	2	50	0	50	0
25.	61	0	42	6	26	10	44	7	55	0	48	4
Nov. 1.	61	11	46	3	26	0	43	6	48	6	47	0
8.	61	7	45	4	26	0	43	2	46	2	48	9
15	60	6	46	6	25	0	42	10	45	2	44	4
22.	61	5	47	4	24	10	42	6	46	4	49	6
29.	60	7	46	4	25	0	41	9	48	2	53	6

DUBLIN.

Date.	Wheat, p. barl. 20 st.		Barley, p. bar. 16 st.		Bere, p. barl. 17 st.		Oats, p. barl. 14 st.		Flour, p. barl 9 st.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d
Sept. 5	36	3	23	9	21	2	16	2	25	2
12.	35	2	23	2	20	8	15	6	24	6
19.	33	4	22	4	20	9	15	1	24	2
26.	33	6	22	6	16	6	14	8	24	3
Oct. 3.	32	10	22	0	14	2	13	7	24	4
10.	33	11	22	3	14	6	13	6	24	6
17.	34	11	21	7	14	1	14	8	24	8
24.	34	0	23	0	14	4	14	0	24	10
31.	32	0	20	6	15	2	13	4	24	9
Nov. 7.	35	2	21	0	14	8	13	0	25	0
14.	35	6	22	0	14	5	13	7	24	8
21.	33	9	22	3	14	6	14	3	24	6
28.	34	3	21	7	15	1	14	6	24	8

TABLE SHOWING THE WEEKLY AVERAGE PRICE OF GRAIN,

Made up in terms of 7th and 8th Geo. IV., c. 58, and 9th and 10th Vict., c. 22. On and after 1st February 1849, the Duty payable on FOREIGN CORN imported is 1s. per quarter, and on Flour or Meal 4½d. for every cwt.

Date.	Wheat. Weekly Average.		Wheat. Aggregate Average.		Barley. Weekly Average.		Barley. Aggregate Average.		Oats. Weekly Average.		Oats. Aggregate Average.		Rye. Weekly Average.		Rye. Aggregate Average.		Pease. Weekly Average.		Pease. Aggregate Average.		Beans. Weekly Average.		Beans. Aggregate Average.	
1856.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Sept. 6.	73	2	72	11	47	6	44	5	27	4	27	3	43	1	44	11	40	9	40	10	45	5	45	2
13.	69	6	71	6	46	8	45	1	25	10	26	11	43	9	44	2	41	0	40	5	45	4	45	2
20.	64	5	69	7	45	10	45	6	27	2	26	11	44	10	43	11	41	9	40	3	46	3	45	3
27.	64	4	68	6	43	10	45	7	26	7	27	0	43	8	43	10	43	8	41	0	45	0	45	4
Oct. 4.	65	0	67	10	42	10	45	3	25	11	26	8	42	0	43	7	43	9	41	10	44	10	45	4
11.	64	9	64	10	42	9	44	11	25	9	26	5	39	11	42	11	43	3	42	4	45	2	45	4
18.	65	9	65	7	44	0	44	4	26	8	26	4	40	1	42	5	44	0	42	11	46	1	45	6
25.	66	4	65	1	45	8	44	2	27	1	26	6	40	11	41	11	44	9	43	7	46	6	45	8
Nov. 1.	66	0	65	4	46	2	44	2	26	7	26	5	41	8	41	5	45	5	44	2	47	2	45	10
8.	65	3	65	6	46	8	44	8	26	5	26	5	40	4	40	10	45	9	44	6	46	0	45	11
15.	64	4	65	5	46	7	45	4	26	2	26	5	41	7	40	9	43	2	44	5	47	3	46	4
22.	63	3	65	2	45	7	45	9	25	7	26	5	40	4	40	10	43	6	44	5	46	3	46	6
29.	61	11	64	6	44	11	45	11	24	8	26	1	42	0	41	2	43	1	44	3	45	6	46	5

FOREIGN MARKETS.—Per Imperial Quarter, free on board.

Date.	Markets.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1856.		s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Sept. ..	Danzig	60 0 - 72 0	28 6 - 37 0	16 6 - 24 0	40 6 - 45 0	36 6 - 42 0	38 6 - 45 0
Oct. ..	Danzig	64 0 - 75 0	30 6 - 40 0	17 6 - 23 0	38 6 - 42 6	38 6 - 44 0	39 6 - 46 0
Nov. ..	Danzig	56 0 - 68 6	30 0 - 38 0	16 0 - 22 0	36 6 - 41 6	35 0 - 41 0	36 6 - 43 0
Sept. ..	Hamburg	60 0 - 70 0	36 6 - 43 6	17 6 - 24 0	34 6 - 44 0	36 0 - 43 0	35 6 - 43 6
Oct. ..	Hamburg	67 0 - 76 6	37 6 - 45 9	16 6 - 23 6	32 6 - 42 0	34 6 - 41 3	33 6 - 40 6
Nov. ..	Hamburg	52 6 - 62 0	32 6 - 40 0	15 6 - 22 0	34 0 - 40 0	32 0 - 40 0	32 6 - 39 6
Sept. ..	Bremen	60 0 - 68 6	32 0 - 40 0	17 6 - 24 6	35 0 - 44 6	38 0 - 45 0	37 6 - 43 0
Oct. ..	Bremen	63 0 - 70 6	34 6 - 41 6	18 6 - 25 0	33 0 - 42 6	39 6 - 47 0	35 6 - 42 6
Nov. ..	Bremen	58 0 - 68 6	30 6 - 38 0	15 6 - 22 0	32 0 - 40 6	34 6 - 42 0	34 0 - 40 6
Sept. ..	Königsberg	63 0 - 70 0	30 6 - 41 0	18 0 - 24 0	30 0 - 40 6	36 6 - 43 0	35 0 - 41 6
Oct. ..	Königsberg	64 0 - 72 0	32 6 - 43 0	16 6 - 23 0	30 6 - 38 6	37 6 - 45 0	36 0 - 44 0
Nov. ..	Königsberg	56 6 - 62 0	30 6 - 36 6	15 6 - 21 6	30 0 - 37 6	30 6 - 37 6	31 6 - 37 0

Freights from the Baltic, from 3s. 6d. to 5s. 6d.; from the Mediterranean, 6s. 6d. to 10s. 6d.; and by steamer from Hamburg, 4s. to 6s. per imperial qr.

THE REVENUE.—From 30th June to 30th September 1856.

	Quarters ending Sept. 30. 1855.	Quarters ending Sept. 30. 1856.	Increase.	Decrease.	Years ending Sept. 30. 1855.	Years ending Sept. 30. 1856.	Increase.	Decrease.
	£	£	£	£	£	£	£	£
Customs	6,081,487	5,981,344	..	37,143	22,842,443	23,093,301	250,858	..
Excise	5,137,000	5,446,000	309,000	..	17,388,170	17,861,778	473,608	..
Stamps	1,652,723	1,770,649	117,926	..	7,259,565	7,180,041	..	79,524
Taxes	154,000	157,000	3,000	..	3,060,499	3,100,026	39,527	..
Post-Office ..	645,000	645,000	..	..	2,709,094	2,763,152	59,058	..
Miscellaneous	255,073	224,170	..	30,873	1,211,383	1,404,438	193,055	..
Property Tax	4,594,858	5,347,236	752,378	..	13,665,205	15,940,831	2,275,128	..
Total Income			1,182,304	68,016			3,291,234	79,524
	Deduct decrease....		68,016		Deduct decrease....		79,524	
	Increase on the qr...		1,114,288		Increase on the year		3,211,710	

PRICES OF BUTCHER-MEAT.—Per Stone of 14 Pounds.

Date.	LONDON. Beef.	LONDON. Mutton.	LIVERPOOL. Beef.	LIVERPOOL. Mutton.	NEWCASTLE. Beef.	NEWCASTLE. Mutton.	EDINBURGH. Beef.	EDINBURGH. Mutton.	GLASGOW. Beef.	GLASGOW. Mutton.
1856.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Sept. ..	7 3 - 8 3	7 9 - 9 0	7 3 - 8 3	7 0 - 8 0	7 3 - 8 0	7 0 - 8 2	6 9 - 8 9	6 9 - 8 9	6 6 - 8 6	6 9 - 8 9
Oct. ..	7 3 - 8 6	7 6 - 8 9	7 0 - 8 0	6 9 - 7 10	5 6 - 7 6	6 3 - 7 9	6 6 - 8 6	6 3 - 8 3	6 3 - 8 3	6 6 - 8 3
Nov. ..	7 6 - 8 6	7 9 - 9 0	7 3 - 8 3	7 3 - 8 3	6 6 - 8 0	6 6 - 8 2	6 6 - 8 3	6 0 - 8 0	6 0 - 8 0	6 0 - 8 0

PRICES OF ENGLISH AND SCOTCH WOOL.—Per Stone of 14 Pounds.

ENGLISH.	s. d. s. d.	SCOTCH.	s. d. s. d.
Merino,	17 6 to 25 0	Leicester Hogg,	18 0 to 22 6
.. in grease,	13 0 to 17 6	.. Ewe and Hogg,	15 6 to 19 6
South-Down,	18 6 to 22 6	Cheviot, white,	15 0 to 17 0
Half-Bred,	14 0 to 18 0	.. laid, washed,	10 6 to 14 0
Leicester Hogg,	18 0 to 22 6	.. .. unwashed,	8 6 to 10 9
.. Ewe and Hogg,	15 6 to 19 6	Moor, white,	7 6 to 11 0
Locks,	8 6 to 10 6	.. laid, washed,	5 6 to 7 6
Moor,	6 6 to 7 6	.. .. unwashed,	4 9 to 6 0

AGRICULTURAL STATISTICS OF 1856.

By an ENUMERATOR.

Published in Transactions of the Highland and Agricultural Society of Scotland with last No. of this Journal.

THE Agricultural Statistics of 1856 have again been presented to their country as a free-will offering by the farmers of Scotland. In a year so exceptional in its agricultural aspects as that which is passed, the collection of them was regarded with no little anxiety by those favourable to obtaining agricultural statistical information throughout the country, of which the plan adopted in Scotland can be regarded as but an example. And there is no doubt that from the above cause the collection has been attended with considerable difficulty this year, and the complete success which has attended it must be cause of congratulation, both to those engaged in it and to the country in general.

In September last, the amount of acreage of the different crops, and the amount of stock, were published, and now we have presented to us, 1. An amended table of acreage under tillage; 2. Proportional acreage of the crops in each county; 3. Estimate of gross produce of the principal crops in each county; 4. Estimate of average acreable produce of the same crops in each county; 5. Estimate of average acreable produce in each district; 6. Estimate of the weight of the cereal crops in each district; 7. List of districts, and Reports by Enumerators on the quality of the crops. It will be observed that there has been a formal extension of the inquiry this year to the particulars contained in Tables 6 and 7; for these last year were only returned as a Supplementary Report by the Enumerators, after the ordinary and regular meetings of the Committees had been held, and the results of the other tables arrived at. It will be observed, also, that Table 2 is an addition to those of last year. We are glad to find this extension of the inquiry and addition to the information, and hope that each year, for some time to come, we will be enabled to mark some further extension; for we must confess, that we consider the information obtained as but incomplete in its present state, but accept it most cheerfully and thankfully, as a foretaste of what we will yet obtain.

TABLE I.—AMENDED TABLE OF ACREAGE UNDER TILLAGE.

The first thing which strikes us in this Table is the great increase of the area under tillage last year, as compared with 1855, viz. 15,122 acres. This we are told in the Report is "perfectly in accordance with the agricultural improvements known to be in operation, and with the inducements which high prices have held out to break up old pasture." This reason we consider quite

sufficient to account for the great difference, and many of our practical readers will agree with us when we state, that the proportion of pasture has been for some years on the decrease; and such was the quantity ploughed up this year in particular counties, that it was difficult to obtain grass for the ordinary amount of stock. The consequence was that the pastures were for the most part overstocked, which, combined with the bad season, made it a most unprofitable year for graziers. As might be expected from the great demand, pasture rents were most extravagant. Now, while the increase in the number of acres under a rotation of crops may be attributed to the breaking up of old pasture and the improvements going on for some years in the total acreage for Scotland, and for some of the counties, such as Aberdeen, Ayr, and Fife, there are some of the other counties which show anomalies (when we consider the nature of the present times) that require explanation. For instance, we find that in the county of Argyll there are 9748 acres less under rotation in 1856 than in 1855; of Kirkcudbright, about 4004 acres; and of Roxburgh, about 8668 acres, less last year than in 1855, making about 22,420 acres in all in these three counties less under rotation in 1856 than in 1855. It will be observed also, that the decrease in grass and hay under rotation in these counties is about equal to the decrease in the total acreage under rotation in them; and it will also be observed, that, in Argyll and Kirkcudbright at least, the proportion in grass is greater than the average. Now what has become of these 22,420 acres? Are we to understand that in a year when there was every inducement, from the high price of grain, to plough up pastures, and which led most farmers in Scotland to do so, the farmers in these three counties pursued a course directly the reverse, viz. that of sowing down their lands to permanent pasture? Or are we to understand that an error has been committed in the returns, either last year or in 1855? We would be inclined to fall back upon the latter conclusion; for though the heading of the column "Grass and Hay under rotation" appears to us distinct enough, we have known farmers more than once return grass not under rotation in the column, which, after the examination of the officials, was detected before the results of the statistics were published. We allude to this, not in any cavilling spirit, but rather with the view of directing attention to what most practical men must consider an anomaly. If it is an error arising from those who made the returns having mistaken the meaning of the heading of the column, we have only to express a hope that it will not be repeated in future returns. We cannot but consider this acreage table defective in so far as it does not give us the whole extent of the country, a much-desired addition to the statistics which we cannot obtain till the ordnance survey is completed. In the mean time, it may be worthy of consideration

whether some alteration on the grass column may not be effected with advantage.

It was natural to expect that in the distribution of the crops in 1856, wheat would occupy an increased acreage from the highly remunerative prices which were obtained for it. An acre of wheat for a few years back has been calculated to be worth, on an average, from £15 to £20, while an acre of barley has not been worth more than from £8 to £10, exclusive of the straw in both cases. There is no class in the community more easily raised or depressed by good and bad fortune than farmers. This has been particularly observable during the last ten years, both in the keen competition for farms in good times, and in a corresponding reluctance to enter on new engagements in dull times, and in the varying extent of cultivation of the different crops according to the rise or fall of their respective values. It is on this account that there was such a large increase in the growth of wheat, viz. 72,027 acres in 1856 more than in 1855, and about "56½ per cent on the returns of 1854." This increased growth of wheat argues a progressive fertility in the soil, and an increased use of manure, both indicating a higher state of agriculture. There was more spring wheat sown last year, in place of barley and oats, than ever was known to have been done in Scotland before. And the great increase will be seen to have taken place in those counties where there was formerly a less proportional breadth of wheat, such as Aberdeen, Sutherland, Kincardine, Kinross, and Peebles. In Aberdeen there were nearly five times more acres in wheat last year than in 1854. We do not find that an increase in the number of acres of wheat is followed by a corresponding decrease in those of barley and oats. But this is sufficiently explained in Mr Maxwell's Report, where it is stated that "the average of the oat crop would probably have shown a much greater decrease than is indicated, had it not been compensated by the grass land, which, according to the ordinary rules of husbandry in this country, was principally broken into oats." It would appear that in those counties where there has been the greatest arbitrary increase of wheat, such as Aberdeen, Fife, and Forfar, there has also been an increase in the grass and hay under rotation, thus proving that a good deal of old grass must have been broken up in these counties to make up for the deficiency which would otherwise have occurred in the acreage of the oats. This makes us the more regret that circumstances will not at present admit of the including of all the pasture in the country in the statistical tables, as we would then be better able to tell what has been added to the cultivated soil of the country from what was before lying in a state of nature, when there has been an increase to the total acreage under tillage, as last year.

There is little more deserving of notice in this table, excepting that, though there has been such a large increase in wheat, it has

not been at the sacrifice of the green crops, for there is a considerable increase in both turnips and potatoes. We do not think, however, that there are really the number of acres in turnips mentioned in the table; for it must be borne in mind that the returns were made in June, when a great deal of the turnips had not then been sown, and we believe in many instances never were, as wet weather came immediately after the returns were sent in, and prevented the operation being proceeded with; so that the figures in the table indicate, in this instance, the intention of the farmer more than the actual results on his farm. If on this account the number of acres in turnips ought to have been less, that in fallow should have been correspondingly more. We observe that there is a falling off in the number of occupants last year to the extent of 554, of which one-fourth is from the county of Lanark.

Appendix—Stock.

We take this table next, as it was published before the others. There is so much uniformity in it, and so little that calls for special remarks, that we will not dwell long upon it. As regards horses, there has been an increase in most of the counties, but specially in those where there has been the greatest increase in acreage under tillage, such as Aberdeen, Ayr, Fife, Forfar; while in Roxburgh, where there has been a decrease in the number of acres under tillage, there are also fewer horses, but not to the extent we would have expected; and in Argyll, though there has been a reduction of nearly 10,000 acres, there is an increase in the number of horses; and similar results are also observable in Kirkcudbright. This, we think, tends to support the opinion we expressed before, that there has been some mistake in the returns made under the heading "Grass and Hay under rotation." There has been an increase in cows and other cattle, but a decrease in calves, making a decrease in the total of cattle. Of sheep there has been an increase in all the divisions, but especially in lambs, of which there were 100,000 more in 1856 than in 1855. We should bear in mind, however, that the returns were made considerably earlier last year than in 1855, and that the time which intervened between the dates of the returns was that during which there was the greatest consumption of lamb, so that this may in some measure account for the great increase in lambs, though the principal reason no doubt is the large crop of them in 1856, so large as to cause a great decline in prices in the end of the season. The greatest increase in lambs is in the county of Inverness, there being 28,000 more in 1856 than in 1855; but there has been a substitution of breeding for feeding-stock here, as indicated by the table, which will account for the increase in lambs. The same is the case with Ayr, where the increase of lambs is 10,000, while there is considerable limitation in the feeding-stock. In Argyll and Dumfries, on the other hand,

there has been a considerable increase in lambs, accompanied by an increase in ewes and feeding-stock; while Lanark shows an increase in ewes, but a decrease in lambs and feeding-stock.

PROPORTIONAL ACREAGE OF THE CROPS IN EACH COUNTY.

This is a valuable addition to the agricultural statistics. There are no new facts presented in the table; we have merely the working out of the facts contained in table No. 1. Those who analysed the statistical tables, and took a pleasure in studying them minutely, would, no doubt, in previous years work out the figures of table No. 1 in the same manner for their own satisfaction. This year, however, they are saved the trouble, and the public have their attention directed to a most interesting corollary of a part of the statistics. To Mr Hall Maxwell and the other officials there are due the thanks of the public for this addition. Let us study it for a little. It is not to be expected that the figures in this table indicate the rotation of any particular county. Even though a particular rotation may prevail in a certain district, still, when returns are made such as those of the statistics, there are often many elements, trifling in themselves, but at the same time numerous enough, and, when collected together, important enough, to disturb the uniformity which otherwise would have prevailed.

It will be observed, that, after striking an average of the proportional acreage of the crops throughout that land, we obtain a distribution of the crops corresponding very nearly to the five-shift course, thus:—

White crops,	. . . .	39.242, or nearly $\frac{2}{5}$.
Green do.	. . . .	19.130, or nearly $\frac{1}{5}$.
Grass and hay,	. . .	41.628, or about $\frac{2}{5}$.

There was also an approximation to this course in the years 1854 and 1855, though in 1856 it was greater, owing to an increase in the proportion of the white and green crops and a decrease in the grass. The largest proportion is in grass in the western counties, such as Ayr, Bute, Dumbarton, Lanark, Renfrew; and the largest proportion in white and green crops in the counties on the eastern side of the island, such as Clackmannan, Edinburgh, Fife, Haddington, Inverness, Ross and Cromarty. The same counties generally have the largest proportion in wheat, while the adaptation of culture to climate, or rather the cultivation of plants most suitable to particular climates, is beautifully brought out in the column under barley, where we observe that cereal distinguished for the softness in the straw, bears but a small proportion to the other crops in the western counties, where there is generally a superabundance of moisture tending to lay soft-strawed grains. A glance at the figures under flax will give some idea of the repute in which it is held by practical men generally in the times of high prices for grain; and the decrease in its cultivation has been very

rapid since 1854, being in the proportion of ·077 in 1856 to ·189 in 1854. It is evident from this that the farmers of Scotland in general do not hold this plant in such high favour as Sir James Graham, who has more than once strongly urged his tenantry to a more extensive cultivation of it. Berwick and Roxburgh grow about the largest proportional quantity of turnips and the least of potatoes; while Argyll has the largest proportion of the latter, Renfrew the next, and the least of turnips in all the counties. We would fain hope that the Highlanders of Argyll are not trusting too much again to this precarious crop, which may produce results as disastrous as occurred in 1846. Clackmannan, Stirling, and Orkney, have the greatest per-centage of bare fallow; and we are surprised to find Haddington so high in the list in this column.

TABLE III.—ESTIMATE OF GROSS PRODUCE PER COUNTY.

The facts most worthy of notice in this table are to be found in the columns under wheat and potatoes. There is an increase in wheat of upwards of 2,200,000 bushels over 1855. As in former years, Fife produces the largest quantity, and shows a great increase; the greatest increase, however, being in Aberdeen; while every county shows a most marked increase—a fact for which we were quite prepared, as every small farmer in a Highland glen could point to some patch of wheat last year growing where barley and oats only were considered suitable, and it would have been thought madness three years ago to attempt the growth of wheat. It is only to be regretted that this first experiment in so many places should have proved so unsuccessful from the untoward harvest, and that so little of the large produce will be fit for human food. There is a decrease of about 500,000 bushels in barley from last year, and an increase of 1,800,000 bushels in oats. Fife produces the largest quantity of barley, as it did of wheat, and Aberdeen grows the most oats, the produce being double that of any other county. There is a slight increase in the produce of turnips, Aberdeen being the greatest producer. There is a great deficiency in the potato crop, the produce of 1856 being little more than half of that of 1855, which was one of the best years for potatoes that most farmers recollect of. It is on this account that some have thought that the potato crop of 1856, which was acknowledged to have been a small one, independent of the disease, which left not more than one-half of the crop fit for the market, has been overestimated, particularly when compared with that of 1855. But it must be borne in mind, that though crop 1855 was a very large one, there was also considerable disease among the tubers, we should say to the extent of one-third of the full crop, and the diseased potatoes are not included in the returns of either year. Those who object to the returns of 1856 forget that there was fully one-third deducted from the gross produce of 1855. We believe that,

from the sad experience of last year, neither wheat nor potatoes will be so extensively cultivated this year.

TABLE IV.—ESTIMATE OF AVERAGE ACREABLE PRODUCE PER COUNTY.

Considering the very peculiar weather we had during summer and harvest last year in most of the Scottish counties, this table will be examined with more than usual interest. And the first thing that will strike the attentive reader will be the generally higher average acreable produce of the white crops in 1856 than in 1855. This is particularly observable of wheat, and almost without exception, in those counties in which the harvest was most unpropitious; while in those that were more highly favoured with the weather, there is a decrease in many instances, in 1856, as compared with 1855. Some will be apt to attribute this unexpected result to negligence in the enumerators in preparing the returns; for it must be admitted that at first sight it seems strange that in a year distinguished for very unfavourable weather, both during summer and harvest, and for great loss of grain from shedding, both from winds and the constant handling of the sheaves, the acreable produce should be greater than in 1855, in which the produce was considered at least an average. But we can account for it in two ways: first, crop 1856 was one of the largest crops we ever saw growing in those counties, in particular, where the crop suffered most; and hence, though we admit that there was considerable loss during harvest from shedding and otherwise, there was still sufficient secured to yield an average number of bolls; secondly, owing to the damp state of the grain threshed, there are more bushels turned out than if it was in a dryer condition. Sutherland, as in former years, holds the first place in the acreable produce in wheat; while Fife, in which is grown the largest quantity of wheat, ranks only in the third class with other counties in the scale of acreable produce. In barley and oats, Haddington is highest, and Inverness lowest. And it is somewhat singular that in wheat, in particular, and in barley and oats, there should be no difference in the produce of the counties on the east and west side of the island. There appears to be less uniformity in the turnip crop than in any of the rest. In some counties there is an equal produce, in others it is greater, and in a third class less in 1856 than in 1855. While this is the case in those counties in which the harvest was most unpropitious, it is especially worthy of observation, that almost invariably in all those counties in which the harvest was reported good, there is a marked decrease in the acreable produce, in Ayrshire amounting to upwards of 7 tons, or not much less than the half of crop 1855. Here, then, is something well worthy of the consideration of the meteorologist; and we trust that that Society which has commenced so auspiciously will soon be able to confer no little benefit on agriculture, from the extensive observations

which are now being made throughout the country by its members. We have tried in vain to discover the same effects of the weather on the potato crop; but the disease, and the peculiar habits of growth of this plant, appear to have set all weather at defiance; for in every county but Caithness and Orkney, we find a large decrease in the produce of the crop in 1856, as compared with 1855.

TABLE V.—ESTIMATE OF THE AVERAGE ACREABLE PRODUCE PER DISTRICT, AND TABLE VI.—WEIGHTS OF GRAIN PER BUSHEL IN EACH DISTRICT,

Contain little which calls for special notice, excepting the slight difference in the weight of the grain throughout the country—a circumstance scarcely expected, considering the great variety of harvest weather which prevailed in the different counties. We pass on, then, to the consideration of the abstracts of the enumerators' reports. These have evidently cost the different district committees no little trouble. It would have been no easy matter, in the districts where the harvest was unpropitious, to arrive at correct conclusions as to the proportion of grain secured before the bad weather in September, and the amount of deterioration suffered by what was exposed. Care should be taken, in making up the abstracts of the reports, that they be as uniform as possible, and that no particulars be mentioned in one that are not stated in the rest, unless such shall have been specially called for by circular. The bare mention of such particulars in one or a few of the abstracts, and not in the whole, gives the appearance of something exceptional in the districts to which such abstracts refer.

A perusal of these reports will give a good idea of the disastrous state of the harvest last year in the principal agricultural counties. We find that there are 17 counties, chiefly in the north and east, in which the storm of September was general. There are others where districts only suffered from it; and in the remainder, on the west coast, for the most part, the harvest was one of the finest that has been for many years. Confining our attention only to the 17 counties, we find that only from $\frac{1}{8}$ to $\frac{1}{4}$ of the crop was secured in good condition, and that what was exposed during the storm has been deteriorated in market value about 23 per cent from the weather, to which we may add 10 per cent from heating in stack, in all 33 per cent. A glance at the reports of the markets will testify that this is no exaggerated estimate. We know of instances where wheat that was secured in good condition brought in the beginning of the season 90s. per quarter for seed, while the same variety of wheat, grown in the same field, but exposed to the storm, brought only 40s. per quarter the other day. This we admit cannot be taken as an example of the whole crop, particularly as there has been a great fall in prices since the first lot was sold, and as it

brought a seed price. But there is no doubt that wheat which, undamaged, would have brought 60s. per quarter, now cannot be sold for more than 40s. And besides, when sold it is quite unfit for baking purposes, and is converted into spirits for the French market.

Now, from the foregoing data, we can arrive at the loss which the farmers in these 17 counties have suffered of crop 1856. The number of acres of crop exposed to the storm would be about 603,400; the price at which the wheat would have sold, if undamaged by rain, would have been 60s. per quarter; of barley, 40s.; and of oats, 28s., or 7s. 6d., 5s., and 3s. 6d. per bushel. The loss from deterioration is 33 per cent; that is, for wheat, 2s. 6d., for barley, 1s. 8d., and for oats, 1s. 2d. per bushel. Besides this loss there was a considerable one from shedding of the grain, and from much of it being so much damaged as to be quite unfit for the food of man or animals. This, which we reckon at 4 bushels per acre, has not, of course, been included in the statistical returns. The straw also, which was deteriorated in value fully one-half, or about 1s. per cwt., we have calculated at the rate of 21 cwt. per acre. The following, then, may be considered an approximation to the loss sustained by the farmers in these seventeen counties:—

3,858,631 bushels wheat, at 2s. 6d. per bushel, . . .	£482,324
3,320,992 „ barley, at 1s. 8d., „	276,749
13,950,451 „ oats, at 1s. 2d., „	813,776
Loss from deterioration in marketable grain and grain consumed at home, ...	£1,572,849
2,413,600 bushels lost by shedding and otherwise, at 4s. 6d. per bushel, ...	543,060
12,671,400 cwt. of straw, at 1s. per cwt., ...	633,570
Total loss on 603,400 acres, that is, at the rate of £4, 10s. per acre, ...	£2,749,479

Some idea may be formed of the damage done to the grain for mealing purposes, when we mention that 18 stones of wheat, of crop 1855, produced 1 stone more of flour than the same weight of wheat of crop 1856, with very little sprout, as it has done at the same date; and 15 quarters of Sandie's oats, of crop 1855, produced 22 stones more of meal than the same quantity and kind of oats of crop 1856, with scarcely any sprout in them, though they were exposed in the stack during the whole of the bad weather. It is very easy to estimate the loss to the country from these data.

This paper would be incomplete—indeed, we would not be discharging our duty towards our fellow-labourers in the collection of agricultural statistics—were we to allow to pass unnoticed the aspersions which have been cast on us by Mr H. Ker Seymer. In his reply to Mr Hall Maxwell, no doubt, he has acknowledged his error; but our protest against the language used by him will confirm the

explanation of Mr Hall Maxwell. We can safely say that the paltry pittance allowed the committees offered no inducement to the members to undertake the duties. Were they not actuated by other motives than a mere mercenary one,—were they not anxious to show that they appreciated the value of agricultural statistics, and were ready to aid in the collection of them, not so much from any benefit they derive from them as farmers, but as members of the community,—were they not willing to discharge their duties as members of the Highland Society when it became the medium for the collection of the statistics—they never would have engaged in the work on the terms they have done. And we will not answer for the same hearty co-operation of all the members of the committees if the connection of the Society with the statistics be severed, and Government take the matter into their own hands. We have no objections to the English county members haranguing their constituents in clap-trap speeches on the eve of a general election; but we do object to their trying to enlist the favour of our English brethren by throwing out insinuations against our character.

ON TROPICAL CULTIVATION, AND ITS LIMITS.

By JOHN G. MACVICAR, D.D., formerly Colonial Chaplain of St Andrew's Church, Colombo, Ceylon.

To those who have not visited the tropics, the idea of the vegetable kingdom there seems like a beautiful dream; and it is generally supposed that if the temperate zones were favoured with a tropical climate, the production of vegetable food could be carried much farther than is possible at present.

After a residence of thirteen years within six degrees of the equator, however, and after bestowing some good measure of scientific attention upon the subject (my love of agriculture first awoke by the establishment of this Journal in Scotland), I am fully convinced that a temperate climate is not more necessary for the full development of the energies of man, than it is for the full production of the most valuable kinds of food. In reference to both, that collocation is to be observed which the wisdom of the Creator does indeed lead us to expect, but which the popular belief refuses to admit, inasmuch as it is granted by all that temperate climates are best for man, but it is thought by many that tropical climates are best for vegetable abundance. And, indeed, if by vegetable abundance *foliage only* be meant, this is true. But if not foliage merely, but seeds, grains, fruits, and roots of the most nutritious and delicious kinds be asked for, it is not within the tropics, but beyond them, that we are to look. This I propose to

show in this paper, in the course of which observations will also fall to be made, calculated, I trust, to throw light on our own agriculture.

The characteristics of an intertropical climate, on which, of course, the character of intertropical vegetation depends, are, intense vertical sunshine, giving a high temperature all the year round, abundance of moisture in the air, and rain coming down in torrents when it falls. And hence at once it is easy to see that the corresponding characteristic of tropical vegetation must be an ample foliage. Even supposing that a tropical climate were as favourable for the production of grains, fruits, roots, and timber, as of leaves (and consequently of leaf-stalks and loosely constructed stems), still an umbrageous foliage would be the characteristic of the vegetable kingdom in that region; for it is only those species to which an umbrageous foliage belongs that can prosper there. So great within the tropics is the impact on the ground, now of the tropical shower, and now of the solar beam, that any piece of land which is exposed to the sky, if it be of strong soil, is, before long, so sadly sodden, and then so hardly baked, that no plant with a delicate stem can do any good in it. The access of the air to the roots is completely prevented; and though the moisture of the subsoil is no doubt retained, so that a robust plant or tree growing in it may continue verdant when plants in light soils are languishing from drought, yet all growth is suspended, as will be easily believed by every scientific agriculturist.

But this is not all that renders the growing of a tropical crop difficult in the open field. The daily variation of temperature is often excessive, and that under circumstances which render such extremes at first sight incredible. Thus, where I resided, the monthly mean temperature never varied more than two, or at most three degrees from the annual mean (which was about 80° Fahr.); and yet under the open sky, when exposed in a clear night in a cinnamon garden, on a tuft of *grass*, I have known the thermometer as low as 52° Fahr.; and when laid on the *ground* in the same place, I have seen it in the sunshine next day at upwards of 140° Fahr.* Under such extremes of terrestrial and solar radiation it will be readily perceived that no crop which has to germinate, as the cereals do, and to exist for a time as a "braird," has any chance of getting on except in a cloudy season. Of such seasons it is no doubt true that there is always one, and sometimes two, in tro-

* The minimum thermometer with which I made these observations was a spirit thermometer. If it had been a mercurial one it would have stood lower; also, that used to measure the solar radiation was a rather large mercurial thermometer, the bulb exposed to the air. If it had been very small, and secluded from the ever-changing air by a glass case, I do not know how high it would have risen. May we not say of the sunbeam itself, that it possesses a white heat?

pical countries every year, and that during them the germination of small grains is possible; but still there is no ground for hoping that such brairds as cover our fields could ever be produced in the tropics. Is it asked how the rice, the sugar-cane, the indigo, escape destruction—the answer is, that the rice "brairds" in water, which is with much art diffused like a lake all over the field where it grows,—that the sugar-cane is a robust vivacious reed, which is propagated by coarse tops and suckers,—and that the indigo is not a little precarious.

In a word, such is the force of the sunbeam in the tropics, that an umbrageous foliage which may protect the ground from the solar impact is on a general view a first condition to the well-being of a plant that is to flourish there. And hence at once a grand distinction between the scientific agriculture of intertropical and of extratropical countries. It is not cereals and green crops so much as it is trees, that ought to be cultivated in the tropics. And, indeed, it is wonderful what an amount of produce may in this way be obtained. Thus, besides a multitude of other products all useful, a single acre of cocoa-nut trees in fair bearing will yield, in the course of a year, from 70 to 80 gallons of oil; and the same area in the same time may yield of plantains or bananas—a fruit which is of a higher nutritious value than the potato (according to the calculations of Humboldt)—no less than three times as much as of potatoes, the half only being skin, the remainder wholly edible, and very palatable. To these we may also add the bread-fruit tree as a wonderfully fine plant for the arboriculture of the tropics.

But as to our more valuable cereals or green crops, or fruit trees, even if they could be acclimatised as to temperature, I do not think that any of them could ever be cultivated with advantage in very low latitudes. Not but by a sufficiently skilful system of agriculture the obstacles raised by the impact of the rain and sunshine could be overcome. But there is another obstacle which, on the large scale at least, seems insuperable, and that is the want of a winter. To those who are not acquainted with the habits and economy of plants, this may seem a strange objection; and it would no doubt be thought that, for all the purposes of vegetation, surely a perpetual summer must be best. But it is certain, on the contrary, that for the production of all the most valuable crops and fruits, a winter is no less indispensable than a summer. It is popularly supposed that a suitable mean temperature is all that is required. But this is not enough. Thus, at a certain elevation above the sea-level, any temperature that is desired may be found; and consequently in tropical countries, if there be mountains sufficiently high, there may be found a climate which, in so far as mean temperature is concerned, may be every way suitable for the wheat, or barley, or oats, or orchard or wall

fruit, or culinary vegetables, of temperate climates. And, indeed, mean temperature being assumed as a sufficient guarantee for success, expensive experiments have been made in certain quarters near the equator to grow these plants, and that with such confidence, that even immigrants have been invited to share the spoil; and a spoil assuredly there was, but not of the kind anticipated. Everything grew, and that luxuriantly; but no stone fruit would ripen, no crop would whiten. In fact, no winter was coming. Now, in stone fruit, it is only in relation to the coming winter that the kernel, and the stone which encloses it, with the delicious pulp which surrounds it, is matured. In grain, it is only to meet the hunger of the early spring that the cereal embryo is surrounded with its granary of meal or flour. It is only in relation to the cold that the bud of the fruit tree assumes that compact spherical granulated structure which gives flowers and fruit as well as foliage when it opens. Not that we owe anything to the cold, considered merely as such; but we owe everything to the repose in the living vegetable which that cold induces. A plant whose distribution by the hand of nature is in a temperate climate, if brought into the tropics, and thus deprived of its winter sleep, becomes a sickly thing. Kept continually on the stretch, and forced to grow day and night all the year, it straggles, and is no longer like itself. This is beautifully brought out in reference to the sweet-brier, in an ode to that plant by Lawson, late missionary at Calcutta—

> O stranger! welcome as a long-lost dream
> Art thou to me, a wanderer like thyself.
> Far from my home, and thine,
> We meet, but oh how chang'd!
>
> Not that thy form less lovely seems to me—
> Thy foliage less perfum'd; but frailer far
> Than when at home thy boughs
> Hung o'er my weary head.
>
> Thou seem'st a tender shade of what thou wert.
> Paler, and shrinking from the sun's deep gaze,
> That urgeth the quick growth
> Of thy transparent leaves.

Such a change upon our favoured plants is not indeed altogether, and in every case, irremediable. Inasmuch as a winter is valuable to the plant, not on account of its cold, but on account of the arrest of the current of life, and the repose which that cold secures, it becomes possible to a certain extent, even under the equinoctial, to similate a winter; for this arrest of the sap, this repose, may be induced by drought as well as by cold. This fact has been verified in Ceylon in reference to the vine. This queen of the vegetable kingdom, it is well known, cannot be made to bear fruit under ordinary methods of cultivation in lower latitudes than the tropics. Within the tropics, and even under the line, it will grow; but it

runs all to wood, or rather to wire, in feeble trailing branches, with nothing to show but a spare sickly leaf here and there. In the hope of improving its condition, this favourite of man was first planted in pits. But no good came of this; and no wonder; for although in the temperate zones, by digging down, you can escape from the summer heat, yet in the torrid zone the deeper you dig the hotter it becomes. Nothing was gained by planting the vine in pits. But at last a method of cultivation was discovered, which both rendered the whole plant comparatively robust, and gave abundant bunches year after year. This consisted in laying bare its roots at the commencement of the dry season. The consequence was, that the plant too became dry. The sap ceased to circulate from drought, just as in temperate climates it does from cold. A winter was imitated, and flower-buds were formed; and then, by covering up the roots on the approach of the rainy season a spring was similated; and when the rains were over, in due time an abundant crop of grapes was gathered. The ripening of the rice crop is to be explained on the same general theory. It is obvious, however, that it is only to a very limited extent that such husbandry would be possible; and it may be safely concluded that the want of a winter, taken together with the soddening effects of the tropical rains, and the baking effects of the tropical sun, forms an insuperable obstacle to the productiveness of the tropics in the most valuable kinds of human food.

An exception may, however, be made in favour of certain leguminous plants of great nutritive value. Various sorts of beans, if not of pease, may be hurried through a rapid life within the tropics, giving a fair crop each time they are sown. And these, when used as a mixed diet along with rice, afford an aliment which, in point of value, surpasses wheaten bread, and which may even be compared with animal food.

Thus, in order to repair the waste of an able-bodied man, and maintain his strength, it follows, according to the statements of Payen,* that if his diet is to consist of bread and butcher-meat, he must consume daily about 2 lb. 3 oz. of the former, and about 10 oz. (free from bones) of the latter—equivalent to about 1 lb. 3 oz. of biscuit, and 2.3 oz. of dried meat—say 1 lb. 5.3 oz. of dry food in all. Now, to attempt to replace the waste of his flesh and blood to the same extent by eating rice only, he must consume 4 lb. 8 oz., which, moreover, before it could be properly cooked, must have absorbed three times that weight of water, making a mess weighing upwards of a stone! which would be quite unmanageable in the course of twenty-four hours. An able-bodied man, therefore, and a good day's work, can never be got from a purely rice diet.

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* See *Des Substances Alimentaires, et des Moyens de les ameliorer.* Pp. 277, *et seq.* Par A. PAYEN, Membre de l'Institut, &c. 1854.

But let the labourer substitute for a portion of his rice 12 oz. of beans; and then (in order to a diet which is perfect, theoretically considered), instead of 4½ lb. of rice, he will not require to consume even 1 lb., so great is the value of the legume in supplying the nitrogenous element in which the rice is so poor. Such is the interesting result flowing from the theory of Liebig and others as to respiratory and flesh-and-blood food, which there exists but little disposition to question, and of which it is surely a fine verification that these most recent results of European science have been acted upon in the East time immemorial. The mixture of rice and beans recommended by the accomplished French philosopher just quoted, is exactly the diet long known in India under the name of Brahmin's food, which that ruling caste has secured for itself.

The mention of leguminous plants, however, suggests the inquiry whether a tropical climate possesses, in reference to the production of the protein compounds, the great advantage over a temperate climate, which it undoubtedly does in reference to the production of mere parenchyme or cellulose. I am disposed to think that it does not; nay, that in tropical vegetation there tends to be embodied quite a minimum of nitrogen. Respiratory food, fibre, fecula, sugar, resin, and oil, both fixed and volatile, solid and liquid, the tropics abundantly produce; but that which is capable of going to the formation of flesh and blood, according to the received theory, is not abundant. Thus, the plantain or banana, the best of tropical products as an article of ordinary diet, even when dried and made into meal, contains only 5.75 per cent of the proteinaceous elements, rice only 7 per cent, the albumen of the cocoanut only 7.6, and the sweet potato only 1.17; while the best oats contain from 14 to 18 per cent, and wheat sometimes as much as 22 per cent.

The consequence is, an inadequate diet for the tropical population, accompanied both by defective strength, and such discomfort during digestion, that, with respect to the poorer classes all over the civilised countries in these latitudes, medicine forms a part of their daily life. Moreover, when unrestrained by religious or other adequate motives, their demand for ardent spirits is extreme. Is it asked what medicine they use—I answer, that all over the East, time immemorial, the greater part of the population of the tropical regions keep their stomachs habitually under the play of a medicine which is at once antacid, tonic, and carminative. It is commonly regarded by Europeans merely as a disgusting custom, like the chewing of tobacco in this country; but the case is very different. It does indeed, like the tobacco, imply both chewing and spitting, and that of a highly coloured spittle in large quantities, which is very offensive; but to this saliva it is a most scientifically compounded bolus that gives rise, which I do not believe that the inhabitants of the tropics could want without serious injury. Their

too sloppy diet requires something of the kind; and, for my own part, I cannot conceive anything better compounded. The antacid is a mild quicklime preserved in the form of a paste, and obtained by calcining, and then boiling, corals and shells. The tonic is tannin mixed with other analogous principles, expressed by chewing, from the areca nut; and the carminative is the spice of the leaf of the betel-pepper, in which the morsel of lime-paste and the bit of areca nut are wrapped when going to be pitched into the mouth for mastication. This done, a flow of saliva follows, which must be spit out, and which, being reddened by the action of the alkali upon the areca, is, it must be confessed, very offensive. The large quantity of quicklime also thus brought continually in contact with the teeth, proves very destructive to them, and gives to many the appearance of old age quite prematurely. But with all its disadvantages, this habitual condiment is of great value to the natives in preserving the tone of the stomach and bowels under the too starchy or saccharine diet to which the character of tropical vegetation invites; and any mischief which follows it, is not to be compared with that which follows the habitual use of ardent spirits, of which, however, intertropical countries supply still more distressing examples than higher latitudes.

But might not a more hearty and nutritious diet—might not vegetable matter, with more of the flesh-and-blood element in it, be raised in equatorial countries by a more scientific husbandry? This is the grand question. It is a question, however, which still exists as such in our own latitudes, and indeed forms the grand inquiry at home. I am disposed to think that there are greater difficulties there than here. Within the tropics, not only is it (on a general view) such plants only as can shade themselves by an abundant foliage that can keep possession of the soil, and flourish, but of these, only such species as can protect their vitals from the depredations of animals. The temperature of the tropics is still more favourable to animal organisation than to vegetable; and there is no end to the reptiles and insects which one meets with everywhere, but that which want of food prescribes. Now, all these creatures are fully aware of the superior value of nitrogenous food. Thus, you may grow watery cucumbers and spongy pumpkins to any extent, and they will not be disturbed till they are ripe; but if you venture to grow a melon, you must enclose even the flower in a muslin bag, else the fruit, as soon as it is formed, will be full of maggots. Nor can one keep a bag of wheat a month in store but it is a mass of weevils. Hence, generally, it is only such fruits, seeds, or vegetables generally, as are too watery, sugary, oily, sharp, or spicy for insects, that can hold their ground long in the tropics, unless they be protected in sufficient husks or shells. Everything naked, nutritious, and mild, has been consumed, and the species exterminated long ago. In

proposing to improve the husbandry and economics of the tropics, it must never be forgotten that the insect world will always have, if possible, both the first and the last bite of everything.

The rapidity with which fermentation and putrefaction set in is also a great inconvenience. And here I may mention a remedy against fermentation which I found somewhere long ago, though I cannot remember where, and which we have tested habitually in our family with perfect success. Suppose a vegetable jelly or marmalade is to be made (and such articles are of great value within the tropics, where butter can scarcely be had), as, for instance, a marmalade of grated pine-apple, with an equal weight of sugar,—such a marmalade (which is quite sweet enough to the taste), if left to itself, will run into fermentation in a few days; but, when it is on the fire, in making, let a mere pinch of sulphate of potass to the gallon be added, it is thereby secured against fermentation for all the time that it is likely to be exposed to it; and the same of other sweetmeats. How to explain this is of course impossible in the present state of chemistry; but if there be zymotics, there is no reason why there may not also be azymotics, and of these, sulphate of potass appears to be one.

I intended in this paper to have given an account (in reference to their bearings on agriculture) of experiments in husbandry made in the regions to which the foregoing pages refer, in a garden furnished to me by the government of Ceylon for this purpose. My belief, on my arrival in that island, was, that it would be possible speedily to make great improvements on the cottage-husbandry of the natives, and thus to add to their wellbeing and enjoyments. The natives proved so precipitate, however, in appropriating the first-fruits of my endeavours (more shortly, they are such thieves), that accurate experiments proved to be very difficult. On other grounds, also, the results turned out to be merely negative, to a degree that was not expected. Or rather, the methods, or no methods, which the natives were already pursuing, proved to be not so bad as they seemed at first sight.

They form, however, such a fine illustration of the extent to which a crop is derived from the atmosphere, and of the fact that if no mineral or saline principles be carried off, crop after crop may be obtained without manuring, that I may mention an instance here. Let us take the cocoa-nut tree, the cultivation of which, as usually practised, consists merely in the absolute neglect of it (except when its fruit is to be plucked, which is done from four to six times a-year, or oftener, if the owners or renters are needy); and let us, as a specimen of native customs, proceed to the planting of the nuts, as the natives do. For this purpose, a sufficient quantity of fully-ripe nuts from a favourite tope must be taken, and stuck endways in some shady place, as stones are in a causeway, with a little earth between and over them to

steady them. Or if it is only a few that we want to grow, and we desire to have young plants of the best kind, we may hang the nuts up by strings in the heart of some shady tree. This is a favourite method of germinating them with the natives of Ceylon. A year after, each with two leaves as yet undivided, and from a cubit to a yard high, they are fit for planting out; in anticipation of which, the proposed field or estate must be enclosed to prevent the intrusion of pigs and cattle, which, though they do not care for the mature leaf, crop the young ones and destroy the plants. And how shall our field or estate be enclosed? A stone wall is out of the question, and even a turf wall not easy to be had. But a ditch with a live fence on the dyke (which is on the inside) is not over-difficult or expensive; for a quick or live fence within the tropics is not a product of years and care as in this country. So favourable is the climate to vegetation, that let but any green sticks, shoots, or branches from the neighbouring hedges and trees be stuck in the ground at the proper season, all and sundry, with very few exceptions, will forthwith strike root, and within the year render the whole fence verdant with foliage; and this though they be tied together at set distances to horizontal splits of bamboo or areca palm by twine made of coir, the fibre of the husk of the cocoa-nut. Thus enclosed, and ready for the young plants, the proposed ground must now be dug with holes, which are usually made square, and about the depth of a cubit, and at the distance of from 20 to 24 feet from each other, giving from 100 to 75 trees to the acre. This done, in the centre of each hole a plant is placed, with earth enough about it to keep it upright, and, if possible, on some happy or memorable day in the family, and the first by the proprietor himself or the "Hope of the house," or some favourite. It is, moreover, not without great virtue to future prosperity if, before inserting the plant in its hole, a handful of salt and a piece of money (generally a quarter farthing) be thrown in. Such is the popular belief, and, to a certain extent, the popular practice. And now, once planted, the plantation grows, requiring nothing, and receiving nothing, ever after, except protection from cattle, until, after seven or eight years, it begins to bear fruit—the trunks of the trees then as thick as they will ever be, and from 9 inches to a foot or more in diameter, and from 6 to 10 feet high, and each crowned by a magnificent brush of graceful foliage, the leaves touching from tree to tree—that is, extending from 20 to 24 feet. In fifteen or twenty years the plantation will be in full bearing, the axil of each leaf in the *best* trees giving a flower-sheath and a bunch of nuts, of which a hundred per tree may be expected on an *average* in the course of the year. And this will go on for forty or fifty years, though not always with the same return. Besides the hundred nuts, each tree will also in the course of the year yield perhaps five or six leaves and

spathes; and these, as well as the nuts, are always carried off to the adjoining cottage or hamlet—the former usually for food, the latter for thatch and torch-light. The consequence is, that the trees in the neighbourhood of the cottage or hamlet soon overtop the others, and show that they are better fed; but the others continue to grow till they attain the height of from 40 to 60 feet, and yield fruit, it is believed, for half a century, and that without ever disappointing, though their only apparent nourishment be merely what a mere bed of sand can afford—for such is the soil in which this maritime palm generally grows. Here, then, we have a beautiful illustration of the productive value of the atmosphere: here is an irrefragable evidence that from the same land a long succession of the same crops may be obtained without manuring, provided none of the saline or mineral ingredients of the soil be carried away. From the cocoa-nut plantation, indeed, a vast quantity of oil is sometimes carried away—carried to Europe. Of oily matter there is in the ripe cocoa-nut no less than 70 per cent; and, as has been already stated, an average tree will yield a gallon per annum. But while the oil is carried off, none of the ingredients of the soil is carried off, for oil is merely an oxygenated hydro-carbon, which the organisation of the tree is competent, with the aid of the sunbeam, to concoct out of the atmosphere.

It is also to be considered, however, that, among the stems of cocoa-nut trees that are truly neglected (or truly cultivated!) there is often growing luxuriantly in their shade abundance of underwood, not so close as to choke the trees and prevent the free access of the air to the roots; and from the foliage, and, it may be, the fruit also of this underwood, which is falling month by month, the cocoa-nut plantation must receive no small nourishment. Add to this, the frequent incursion of the pig, wild or tame, which, in seeking for the tips of the roots, which are a favourite food, grubs up the ground—and there is a system of husbandry from which one at first sight recoils, and which nevertheless is, after all, something better than it is easy to accomplish otherwise at the same cost!

Let us not fail to remark, however, that the various products of the cocoa-nut contain but little nitrogen. If they did, I doubt not but ammoniacal manures would require to be applied, at least to a certain extent, if large crops were to be annually produced.

Up to the extent of her appointed duty or function, namely, to produce seed adequate to continue the species in normal extent, doubtless Nature has the means of assimilating or of composing ammonia, and does so without the help of man. But if it is our aim to produce seed which we are again to destroy or consume on ourselves, it seems to be incumbent upon us to help Nature with a supply of ammonia, for this it obviously costs her an effort to provide for herself beyond her own wants.

It consists with the known laws of organic life, however, that

if we give a little, she will add more. Call it catalysis, fermentation, imitation, assimilation, or any other name, it is certain that when an organ or mixture is aiming at the development or construction of a certain substance, the introduction and presence in the region of effort of even a minute portion of that substance, converts that effort into accomplishment. I am persuaded that the day is coming when the grand discovery for agriculture will be made of the development of ammonia out of its elements by agricultural processes. The recent experiments in Paris of G. Ville* (now continued at the expense of the Institute), prove that, in the combustion products of his experimental crops more nitrogen made its appearance than existed in the seeds sown, or was anyhow admitted to them except in the nitrogen of the atmosphere. But I do not think that we are warranted from this to trust anything to the atmosphere, except as it acts in developing ammonia in the water with which the plants were supplied. That water, however carefully distilled, was always found to contain ammonia. The question is, whether methods may not yet be found for developing spontaneously in water ammonia to all the extent that plants can take it up—no matter where the elements of the ammonia come from.

CHARACTERISTICS OF THE YEAR 1856.

By Mr John Towers.

The *first* month of 1856 came in as the *twelfth* of 1855 had departed—that is, with the night-thermometer at the freezing point (32°), rising by mid-day 10°; the wind easterly, and the barometer falling.

In the monthly table before me, *January* divides itself into four distinct periods. The *First* includes 8 entire days, on the last of which, the wind having veered to the north—the mercury standing at 29 inches—the mild temperature gave way to an accession of gentle and seasonable frosts. The meteorology of this period comprises 4 dry days,—1st, 2d, 7th, and 8th, the four intermediate days being more or less showery, and producing a rainfall of 0.347 by the gauge.

Second Period.—This was frosty, and was introduced by a little snow and sleet on the 9th, melting as they fell, the air being just above the freezing point. The lowest temperature was 24° on the 13th and 15th mornings before sunrise. The barometer had risen to 30.57, with wind at north-east; but it fell rapidly, with a

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* See *Recherches Experimentales sur la Végétation.* Par M. Georges Ville. "Absorpsion de l'Azote de l'Air par les Plantes." Paris, 1855.

change to south-west on the 15th, when the temperature rose from 24° to 41° by 2 o'clock. A total change then took place, and introduced the

Third, or *Rainy Period*, which extends to the 26th; the barometer progressively declined, till on the 24th evening it marked 28.99. The wind was south-westerly, with one exception to north-east, during a few hours of the 22d. On the 24th its force amounted to a gale, with driving showers of rain. My gauge measured 1.242 of water, which fell between the 15th and 27th days. The temperature rose many degrees above 36°.1—the usual mean of January.

The Fourth Period commenced with a change of wind to north-west on the 27th morning. The barometer at 8 A.M. marked 29.65, on 30th evening only 29.30; thence gradually rising, with some intermissions, till on the 31st it darted up to 30.05, then to 30.20, or nine-tenths in 24 hours. The temperature fell to 33° at night of the 27th. Our registering instrument marked 28°, 24°, 26° as the greatest depression of the 5 nights; but the maximum of the 5 days exceeded 38° as the total mean. The instrumental average of the whole month by my tables are—barometric, 29.56; thermometric, minimum 35°.7, day maximum 43°, mean 39°.35; or 3° above the usual mean of the first month. Sun shone out more or less on 11 of the days. Rain fell on 19, and the quantity gauged by me amounted to 2.17 inches.

The condition of the crops appeared promising, but the more searching the observations I was able to make, led to the conclusion that the land in the aggregate is neither half tilled nor drained; it is deficient in depth to a great extent, if we appeal as a guide to the deep-land system adopted by the Marquess of Tweeddale, or to the *Chronicles of a Clay Farm*, by Talpa. Farming, therefore, in East Surrey, must be considered as at a low ebb.

February—"fill ditch," so styled, at least in the olden time, until the alteration of the style in 1752, when 12 days were subtracted from the year, and it was enacted that the "2d day of September shall be accounted the 14th day." How far the February of the present time justifies its qualification, the reader must *locally* decide for himself. Referring to the *Characteristics* of late years, and considering the small volume of rain which is registered on the meteorological table of 1856, it should appear that the month now under report has been anything but wet. Before entering into particular details, attention is directed to the following lines, extracted from the late Dr Aikin's *Natural History of the Years*, a little volume, published in 1798, replete with matter equally entertaining and instructive. "The hard weather generally breaks up with a sudden thaw, attended by a south wind and rain, which all at once dissolves the snow. Torrents of water then pour from the hills; every brook is swelled into a large stream, which rush

violently into the rivers. The frost, however, usually returns for a time, when fresh snow falls, often in great quantities, and thus the weather alternately changes during the month."

February divides itself into four periods; two of them dry, cold, if not actually frosty; and two with comparatively high temperature, considerably above the average of many years (38°).

First Period—of four days (1st to 4th).—The barometer, 30.5. Thermometer below freezing about 3° on each night, rising to above 38° Fahr., as the average maximum. Wind was southerly by east or west, and calm or gentle.

The *Second Period* of 11 days terminated with the 15th. The barometer fell from 30.15, fluctuating between that figure and 29.7, its lowest mark. The wind was south-westerly, and raised the temperature 7° to 8° above the estimated average of many seasons. Rainy and changeable weather prevailed. The extent of the rainfall gauged at Croydon was 0.767. The sun shone out on the 5th, 9th, 14th, and 15th; the other 5 days were generally overcast.

Third Period characteristics:—

The wind suddenly chopped round to the east on the 16th, became brisk, and settled at north-east, fresh or lively in force during 4 days. A frosty atmosphere was thus reintroduced, and on the 22d morning the night-thermometer was read at 29° Fahr. The barometer remained below 30 inches, and the air was vaporous. The sky also was overcast with clouds throughout the period. Rain on the 18th night produced 0.99 of water, to which may be added 0.93 of snow, melting soon after it fell on 21st. A lunar halo of extreme beauty occurred in the 15th evening; it enclosed the planet Saturn, the stars Betelguese in Orion's Shoulder, Capella, the two stars of Gemini, and several others of less magnitude. This phenomenon preceded the above dry alternation.

The *Fourth Period* commenced on the 23d, and terminated with the 29th. The barometer rose on the 23d from 29.97 to 30.20 by 10 o'clock at night, thence steadily advancing to 30.56 at the same hour of the 29th. The current varied between north-west, west-south-west, and east-south-east, affecting the temperature more or less. Two of the mornings were cold (at 32°), but all the days were warm (47° to 53°); therefore the average of each is estimated at 4°.4 above that of February. My tables thus register the instrumental averages of the entire month: Barometer, 29.86; thermometer, 42°.08; excess, about 4°. Eighteen of the days were dry, though very frequently overcast. Rain to the amount of 0.888 only was gauged by me. Agricultural prospects —always making allowance for the inadequacy of drainage—are unfavourable; but the recurrence of frosty intervals has prevented any great advances in growth.

March, the month so important to agriculture, comprises three irregular periods.

The *First* includes half the month, and terminates at mid-day of the 16th, when the night-frosts gave way, and the temperature rose from 31° to 50°; that is 19° in a few hours. The barometer ranged extremely high; the mercury stood at 30.58 on the 1st and 2d days, and averaged above 30 inches till the 16th. The temperature retained the genial warmth with which February closed during the two first days, and on the 2d it was 9° in excess. Thence to the 16th it fell below the average mean, the depression on the 12th amounting to 10°. Nearly the whole period was cloudy, the prevailing winds being easterly. Sunny gleams occurred in the second week, and the atmosphere became bright on the 13th and 14th.

The *Second or Changeable Period* commenced at mid-day of the 16th, when the barometer fell below 30 inches. The wind veered to south of east, and the first rain of any account fell; it was gauged by me at 0.402. Again, on 18th, 0.20, and finally 0.015 on the 20th. This was the *equinoctial* day, when the sun crossed into the spring sign *Aries*. The winds had fluctuated between east-south-east and north-west till the full moon of Good Friday, the 21st, when

The *Third Period* commenced. The barometer had risen to 30.6 on the 22d, and fine cold drying weather was established. The chief characteristic of the period was the piercing and forcible easterly current of the fourth week. The mornings were overcast, and there were a few bright gleams till the 27th; the sun then burst forth with power, the atmosphere became pellucid, the sky assuming a rich azure, which is of rare occurrence in our vaporous climate. At this season of unwonted brilliancy, Peace was signed by the plenipotentiaries of the belligerent powers, as if under the peculiar sanction of approving heaven.

The general meteorology of March may be thus summed up: The barometric average at Croydon was 30.082. The thermometer by three daily registers gave 39°.4, being nearly 3° below the usual mean of the month. There were 16 cloudy days, and 15 with more or less sun. The prevailing winds were north and north-east on 11 days, east and to south on 14, south to west on 3, and west to north on 2 days. The rain of the month measured only 0.637 inches.

April.—A month of changes, but of a nature to establish its showery character. The movements of the barometer indicated its periods. On the 1st day the mercury marked 29.93 at 8 A.M., it then fluctuated between 29.93 and 29.15, its greatest depression, on the 10th day.

The *First Period* of 14 complete days includes that copious supply of rain which fell during a prevalence of south-westerly winds,

and amounted to 1.45 inches. Six of the days were fine and dry, the others showery, yet with many sunny gleams. The temperature, though in excess on 6 days, was still, on the whole, below the estimated averages. The wind varied much in force, and was very strong on the 2d. The current changed to north-east on the 14th, with a rise in the barometer to 30.07 on the 15th.

The *Second Period* comprised 10 days, from the 15th evening to the 25th day. The barometer stood about 30 inches till the 22d. The current varied from east by south-east, till it passed the south on the 25th. In force these winds on the whole were keen and cutting; they dried the land rapidly, and a return of showers became desirable. The night-temperature was low, approaching the freezing point as the mean, and falling 1° below it on the 23d. The days were often sunny after noon, and the thermometer rose to 70° as its maximum at 2 P.M. of the 25th.

Third Period (to the end of the month).—The barometer had progressively declined again to 29.49, and changeable weather approached. Much rain fell, and the last day was showery. The instrumental averages cited from my diary of April are the following: Barometer, 29.737; thermometer (the total mean of three daily readings) being 2°.46 below the estimated mean. Rain fell on eleven occasions, often in the night; total amount, by me, 2.414 inches. Nineteen of the days were without rain, and more or less sunny, with few exceptions. Vegetation was certainly retarded by the low temperature, yet there can be little doubt that, at the close of the month, every crop was highly promising. The wheat improved gradually, the land was in fine order, much spring corn had been sown, and some oats and barley were visible.

May.—This month will admit of two well-defined periods only: a dry and a wet one. The *first* extends to the 12th day inclusive, during which the barometer ranged between 29.51 and 29.70 on the 1st day, rose to 30.20 on the 9th, with fluctuations, and thence declined to 29.73. There were 10 fine days, with a fair amount of sunshine. The night of the 4th was cold, with 3° of frost at daybreak of the 5th. Much rain fell in the 6th night, gauged at 0.25 in., and on the 7th day—a wet one—yielded a fall of 0.28 in. The general temperature was much too low for the season; that is, on the average above 8° below the usual daily mean, even allowing 4° plus on the 11th day, when the average rose to 56° of Fahr.

The prevailing wind here was north-north-east, scarcely without exception. The force amounted nearly to a gale on the 7th. There is much interest attached to the quarters from which winds blow, as is plainly exemplified in the aerial map that is placed near the Telegraph Office of the Crystal Palace at 9 or 10 o'clock of each morning. The arrow, which points to the wind at every given town or locality, deviates materially, and I have rarely

failed to notice a directly opposite position of the dart to the prevailing current in several places, not even remote.

Second Period.—On the 12th the wind changed from north-east to south-east; the barometer fell from 29.80 to 27.73, and rain commenced at 5 P.M. The wind went by the south to south-west, and in that quarter it continued, with very few exceptions, till the 28th. Much rain fell on fifteen occasions, which completely saturated the earth, and retarded the advance of the autumn-sown wheat. This most important of the cereals is known to affect a strong loamy soil. When, therefore, such land becomes soaked during a period of unwontedly low temperature, the growth of the ear must be slow. I collected several culms at different periods, and became at length certain that, however healthful a cold May may be to many, a very depressed temperature with much rain in the last week, must assuredly tend to produce a late harvest; and the last three days of this month were on the average so cold as to give a mean *daily* return of 6° below the usual estimate.

In reviewing the meteorology of the month by my instruments, I find the barometric average to be 29.981, the highest register being 30.10, 30.11, and 30.19 on the 5th, 20th, and 30th days; the greatest depression (29.41) during a few hours on the 7th. The mean of three daily inspections of the mercurial and spirit thermometers gave only 49°, or more than 4° too low.

Rain fell on 20 of the days or nights to the measured extent of 3.937 in. There were only 11 days without rain. The course of the winds was decidedly at a south-western point from 13th to 28th day. It was calm on that day, and then settled in north or north-east.

June.—Three distinct and well-defined periods require particular notice, being dependent on the weather. The *first* includes 11 days. The rains of May ceased on the last night of that month, the barometer rising (and not ceasing to rise) till it marked 30.33 on the 7th of June—its maximum—whence the mercury declined to 30.01 in the 11th night. The weather was dry throughout, with a fair proportion of sun, particularly on the 3d, 9th, 10th, and 11th. On the last of these, at 9 or 10 P.M., a faint but coloured halo (*parseline*) nearly enclosed the moon and planet Mars, which were in conjunction, the former having passed her first quarter.

The winds came from a south-westerly point, maintaining a genial temperature much above that of 57°, the estimated mean. The current varied to a northerly point for three or four days in the first week, and then the temperature was reduced about 3°.

Second, or *Wet Period*, commenced on the 12th with a forcible wind at south-south-west, an overcast sky, a fall of the mercury to 29.94, and a reduction of 1° of temperature. Showers fell on the

evening and on the two following days. The weather cleared, and remained pretty fine till the 19th. Then, either by night or day, rain fell in considerable quantity till the 21st, when the barometer again rose from 29.80 to 30.10. Several thunder-showers fell on the 14th, with fine intervals. A most superb rainbow (iris) glorified the east at 6 P.M. On the 20th a powerful crashing thunderstorm passed over the Crystal Palace, and took a south-western course. It was made remarkable by a series of single reports like those of artillery; but these, and the storm in general, had much abated before the clouds reached Croydon. The rainfall was gauged at 0.32 cents: the total fall of the period 1.033 inches.

Third Period.—Perfectly fine to the end of the month; and most favourable for the ingathering of vast breadths of the finest crop of meadow and mixed grasses within record. The barometer ranged between 30.02 and 30.34. The temperature also became high; its maximum 80° on the 26th. The instrumental averages of the month may be thus stated: Barometer, 30.072; thermometer, by three daily observations, 59°.4—most of the nights being cool. There were 22 dry days—8 with more or less rain. The winds were south-westerly on 21 days; north-west on 4 days; 2 at north-east. The other 3 were calm or variable. Wheat was not seen *in ear* by me till 21st day; in flower on the 28th—and barley was in ear on 26th. Rain of the month 1.145.

July cannot be divided in regular periods, being of that motley character which it often assumes in our changeable climate. At the same time, its weather, though somewhat fickle, was extremely favourable to the prospects of agriculture, and certainly may be placed in strong contrast with that of the previous year.

In the first place, the strong forcing temperature, high barometer, and brilliant sun, which graced the closing week of June, continued till a change of wind to west-south-west brought in some rain on the 4th, with heavy masses of smoky clouds. The weather then became showery, and the nights cool; but the day temperature remained genial, and the meadows were refreshed after they had yielded to the scythe that vast mass of herbage which has filled the homesteads with a store of ricks that few have witnessed for several past years. The mercury had fallen from 30.26 on the 3d day to 29.38 (its lowest) for a few hours on the 8th; but it rose again to 30 on the 12th, and by that day 0.5—that is, half an inch superficial of rainfall had been gauged. On the 15th, after great heat (75°), there was thunder, and a night-storm with a profuse shower. On the 16th another electrical display cleared the air, and the mercury rapidly advanced from 29.85 to 30.05. I gauged 0.797 inches of rain as the results of those showers. Fine and balmy weather continued, with high barometer, above 30, till the 22d.

On the 23d the heat was 82° maximum, and 72° at 10 P.M., with

lightning. The weather remained beautiful till one clap of thunder occurred about 5 P.M. of the 26th, succeeded by a few dripping showers, which produced 0.28 cents of rain. The barometer rose progressively to the end of July, when it marked 30.31. The temperature had become intense and forcing at 84°, and perfectly fine maturing weather was established. The *averages* are tabulated at—barometric mean of the month, 30.027; thermometric, 61°.3 by three observations. The winds varied little from south-west to west. On the 31st a lively current from east by south set in, and the month closed in beauty. During the 13 days on which showers fell, a total of 1.715 inches were gauged.

The chief phenomena, in addition to those displayed by electricity, were the remarkable apparent contact of the moon and Jupiter at 14 minutes after midnight of the 22d, and the superbly beautiful irises of the 26th during the protracted showers.

August admits of three well-defined periods. The *first*, which may be viewed as a continuance of the splendid and hot weather of the three last days of July, comprised the first week of this month. It was introduced by a wind at east and north-east. The barometer stood several cents above 30 inches, and the maximum temperature averaged 79°.5; that is, 3½° above 76°, the ordinary degree of summer heat with us. This forcing weather brought on the wheat with rapidity, and reaping commenced on or about the 5th. Much was safely ricked in Surrey, Kent, and, we were informed, in Middlesex, Hertford, and Berkshire. A change of wind to south-west on the 7th threatened rain, and a little fell on the 9th and 11th. This threat in some degree abated the panic, which occurred in the Mark Lane corn-market, of the 4th day, when wheat was reduced from 15s. to 12s. per quarter. The heat continued in excess until the copious rainfall of the 13th (gauged at 0.386 of an inch) occurred. Alarm was then sounded. The temperature declined, and on the 16th morning was 50°.

The *Second*, or *Wet Period*, was introduced with a fall of rain which amounted to 0.31 inches. With the single exception of the 18th (a fine day), the weather remained wet till the 23d, and nearly 2 inches of water were measured. The current fluctuated from north-east, south-east, south, then suddenly to north on the 22d, bringing heavy masses of clouds and one final shower.

Third Period.—The weather cleared, and the 23d proved a fine day, but with the lowest temperature of the month, as the thermometer had marked only 45° in the preceding night, and did not rise above 65° in the course of the day. Westerly winds prevailed to the end of the month, and little more than 0.054 cents of rain during the 9 days.

Harvest operations were not suspended in any of the metropolitan counties.

The instrumental averages of the month in my tables were the

following: By the barometer, 29.913; by the thermometer, lowest reading 56°.4, highest 72°.48; 10 P.M., 64°.6. Rain, by a 64 square-inch gauge, 2.664 inches. There were 18 dry days with much sun, 13 in which more or less fell, the greatest volume on the 19th and 20th. Most of the wheat was housed or in rick, and a large breadth of oats also.

September is, by its meteorology, arranged under two well-marked periods. The first was dry, with a trifling exception, and extends to the 17th night. It was fine, but had become cool, the average temperature being several degrees below the usually adopted mean of this month (nearly 59°). The highest was 73° in the 10th, the lowest 43° in the 3d night. The wind, a mere gentle air, on the first 3 days, changed to south-east, but remained so gentle as to be almost calm. The temperature improved during 4 days, and averaged about 60°, but it receded with the wind at north-east and north-west to 54° and 56° during 4 days, and thus the period closed.

Harvest operations had proceeded safely, and little if any corn was seen around Croydon on the 11th, unless we may except one vast field of barley on high ground, rising southward toward the chalk ridge that approaches the Epsom downs.

Second, or *Wet Period.*—On the 17th the barometer fell from 30.15 to 29.86; the wind became south-westerly, clouds formed, and a sprinkling of rain fell in the evening. The temporary return of gentle north-west breezes rendered the days fine, but great volumes of water fell in the night. Thus, on the 18th and 19th, my gauge returned 0.375 inches. The 20th was fine, but every succeeding day or night was rainy till the 30th, on which day the rain of September had amounted to 2.957 inches. The barometer was always below 30 after the 20th day, and on the 28th it was read off at 28.74. The mercury ascended rapidly on the 30th to 29.77, the wind veered from south-west to west and to north-west, and at that point the weather became fine, comparatively warm and sunny.

Previous to the rain of the 18th, the sun had, on several occasions, set among clouds gorgeously illuminated with a tint so red as almost to amount to crimson. This, however, with the prevailing wind, the depressed temperature, and falling glass, were premonitory of some important change nigh at hand.

The averages of the month were the following: Barometer, 29.804; thermometer, mean, 55°.08, or 2° minus, taking 57°.8 as the usual average. The rain, however unpropitious to the northern harvest, proved vastly beneficial to the root and fodder crops of the southern counties.

October was characterised by several well-defined series of phenomena. For instance, the entire period to the 2d day was much warmer than the usual mean of the month, and at complete vari-

ance with the depressed temperature of September. Thus a total of about 94° Fahrenheit stand tabulated as the results of the daily calculations. Those 94°, being distributed among 25 days of warm weather, will yield a mean of about 3°.8 per diem. If *thermometers* have furnished these data, we find considerable fluctuations in the *barometric* readings; for the mercury stood a few cents below 30 inches till the evening of the 7th, the rainfall of the period here being 0.58 inches. But so decided a rise in the barometer then occurred, that the average returns with me, and also by the tables given at Chiswick and at Camberwell, report 30.20. The greatest elevation was read off, on the 24th and 25th, at 30.48. A singular fluctuation was also remarked on the 15th, when the mercury receded to 29.50, but speedily recovered its altitude, and marked 30.25 on the 16th. Rain, to the extent of 1.22, was gauged between the 9th and 17th days, when fine and dry weather prevailed to the 30th; then in the night, and on the 31st, without any other indication than a change of wind to south-west and south-east, 0.38 inches of rain fell. After these general observations, it must be stated that the fine and dry weather, which was established on the 17th, continued without interruption till the 31st. But it comprised two periods: the first, to the 24th, was warm, the average mean exceeding the one usually adopted (48°.9). Here I may be permitted to protest against the arbitrary claim of one single thermometric reading of temperature as the average of a whole month. Admitting that 48°.9 may be the net average of 30 or 31 days, the decline of temperature must in general be progressive from the first to the last day. Therefore I venture to mark the mean of the first 7 days at 52°, the middle of the month at 48°.9, and the close at 45° or 44°.

Second, or Cold Period, was introduced by lively currents from an easterly point. It comprised only 5 days, 25th to 30th inclusively. The greatest degree of mean cold reduced the thermometer to 38°.3, or 7°.7 below the above estimated average. The 31st day was warmer than the mean (51°.7). The meteorological data of this important month were as follows:—Barometer, 30.123; thermometer, 51°.78, *i. e.* 2° plus; rain-gauge, 2.095 inches. The prevailing winds, south to west, about 8 days; north-east, 7 days; east to south, 12 days; variable or calm, 3 days; dry days, 20; and 14 more or less rainy. The agricultural results were very important. The fine warm rains produced great verdure of the meadows and pastures; the root crops increased rapidly in bulk, the mangel-wurzel particularly; the land became in fine working condition for ploughing and sowing the wheat, which was evident from the germination and growth of the plant. The promise thus given was most satisfactory.

November.—This 11th month of the year demands strict and minute attention, on account of the peculiar arrangements of

its meteorology. It admits of three periods, which arrange themselves in the order wherein they occurred. The *first* includes 8 days of fine weather, comparable with that of October—and more remarkably so, as the high range of the barometer suffered little depression below 30 inches during 24 consecutive days; that is, from the 15th of October to the 8th of November, both inclusive. On the 25th of the former month the mercury stood at 30.48, and on the 7th of the latter at 30.53, an altitude which I have rarely observed in Croydon. The winds varied between north-west, east by north, and south-east. The first rain of November fell on the afternoon of the 8th.

The temperature was warm during the 4 early days (nearly 4° daily in excess), but it was greatly reduced by the north-east wind of the 5th.

Second Period.—The cold increased, and there were repeated frosts between the 6th and 18th, the night-thermometer marking 32°.28, and once 27°, each *succeeded by rain after rime on the herbage.* The direction of the winds, and the fluctuations of the barometer, appeared to have no influence upon the weather, for the westerly breezes produced no warmth; nor did the steady rise of the mercury (from 29.66 on the 12th to 30.26 on the 22d) obviate the rain which fell on alternate days and nights. Thus the gauge measured 0.567 thousandths between the 12th and 22d. This period virtually extends to the 19th, when warm temperature again returned, and continued till the 24th inclusive, the wind being westerly by north or south.

Third, or Winterly Period, comprises the 6 remaining days. The mercury fell from 30.03 to 29.69, and the night self-regulating thermometer from 37° on the 25th to 23° on the 30th, with thick ice.

Atmospheric Phenomena.—Haze and fogs were of frequent occurrence, and even when the sun shone out, dense smoky vapour, blending with cloudy masses, obscured his splendour. Persons who retrace similar circumstances—as, for instance, the commencement of winter in 1814—were inclined to regard the dry hazes of this November as premonitions of an approaching severe winter; and in truth the frosts were early and severe. On many occasions the sun set as a fiery globe, and the western horizon was then lighted up with a splendour of rich orange which admits of no adequate description. The three last days of the month were fine and dry, and the 30th evening, after the keenest frost of the season (at 23°), the south-west horizon was peculiarly glowing.

Referring to meteoric averages, my tables report the barometric readings at 30.005; those of the thermometer, 39°.05. The wind at south-west 7 days; north-west, 17 days; north and north-east, 3; south and south-east, 4 days. Total fall of rain and snow-water, 1.152.

December.—The weather of this twelfth month is characterised by series of antagonistic phenomena, which I describe almost as they occurred.

The *First Period* comprises the four early days. The barometer fluctuated between 29.85 and 29.96. The air was frosty, the wind north-west, west, east by north, and south-west. The sun shone out on 1st and 2d; a little snow, followed by rain = 0.22 cents, fell on the 3d, and this fluctuation introduced

The Second or Wet Period, which comprised the 5th and 13th days. The change commenced with a gentle south-westerly current, which became excessively violent on the 5th, the mean temperature having increased 13°. The wind remained forcible till the 8th, bringing much rain in the nights. The 7th was fine, but the remaining 5 days were extremely showery, and during that short time I gauged 1.423 inches of rain. The barometer marked 29.64 at 8 A.M. of the 5th, and it declined to 28.94 at the same hour of the 13th. The temperature was always in excess, if we assume 40° as the mean of the period. On the 7th my table gives 55°.3, and 54° plus on the 8th and 9th. On the 14th day the excess was reduced to 2°, but the wind had veered to north-west and north; and

The Third Period was introduced. The night of the 15th was frosty, and my spirit-thermometer marked 26° on the 16th, and 25° on the 17th. A great change commenced on the 18th, and the temperature became plus, and so remained till the 23d, when frosts again set in, and continued till the evening of the 29th. The lowest degree of the winter here was 18° Fahr. on the 28th morning. Since that day the weather has been fine and balmy, the thermometer at 10 P.M. of the 31st being read at 47°.

To wind up the meteorological data of December I quote the barometer at 29.765 inches, the thermometric mean as 41°.175, and the rain 2.171 inches. The total amount of the year's rainfall is 23.945 inches by my square gauge.

SALMON AND PISCICULTURE.

NATURE'S many-leaved book is open to all her children, and in greater or in less degree we all enjoy her teaching. A child, a peasant, or a philosopher, each finds something to interest him in the gambols of animals, the flight of birds, the swarming hosts of insects; the growth of trees, plants, and herbs; the properties of the air, the fantastic pageantry of the shifting clouds, the lightning's flash, and the thunder's roar.

It must be so; we cannot shut our eyes to the beauty and the beneficence by which we are surrounded. Although we remember it not, our young souls were filled with wonder when first we saw the moon walking in her brightness; and so willing are we to make the acquaintance of any living thing, that childhood has no dearer joy than to be the possessor of some favourite beast or bird. This instinctive love of natural objects, of which we know not the value or the use, does not always grow with our growth, and develop itself in the tastes and pursuits of the scientific naturalist. Our education may be, and too often is, neglected. We receive instruction only from the printed book instead of from "the infinite book of Nature's secrecy," which has charms for all, because its letters are not inky symbols, the meaning of which we painfully acquire, but the sparkling stars, the towering hills, and the heaving waves of the sea. Of late the popular mind in this country has become much more alive to the charming occupation to be found in the study of natural history. Philosophers proclaim that we cannot know ourselves, and be intelligently aware of our pre-eminence above all earthly creatures, unless we compare their material organisation with our own, and their unreasoning instincts with the capabilities of our higher intelligence. Nor is the public reluctant to listen to such philosophy. Witness the interest taken in the ontological speculations of Professor Owen, when unfolding archetypal forms, and finding the rudimentary idea of our wondrously compacted frame in the backbone of a primeval fish. Our utilitarian politicians, moreover, by the introduction of natural history into the examination of aspirants to the civil service in India, have at last publicly confessed, that not to be acquainted with the properties of material objects and with the habits of living creatures, is to deprive ourselves of the benefit resulting from that subserviency to our purposes with which they have been created, as well as expose ourselves to the injuries which many of them are capable of inflicting. We cannot afford to be ignorant of the ways and doings of any of God's creatures. They may feed us, clothe us, work for us, but they can also torment, terrify, and kill us; ravage our choicest substance, and ruin our costliest labours. A tiny insect

may blast our fields, or riddle like a sieve the proudest of those floating citadels which guard our sea-girt isle.

A maritime people is peculiarly interested in the natural history of the ocean and its inhabitants, and of those great rivers and lakes which are the highways of commerce. Dryden insists that for the idea of a ship we are indebted to the form of a fish; and the sagacious Paley is confident that plate-armour was suggested by the lobster's tail.

Our interest in fishes is determined by our position. Great Britain and Ireland have a coast-line of more than 4000 miles; and of the more than 8000 fishes described by naturalists 253 inhabit the fresh waters of Britain and the surrounding seas. Our shores abound with those kinds of fish which exist in the largest numbers, and yield a supply of the most grateful food. Our fisheries are an important branch of national industry, and add largely to our national wealth; so that a serious diminution in their produce would affect the comfort of all, and be ruinous to multitudes of our people. But while we have such special reasons for investigating the natural history of fishes, manifold are the difficulties in the way of attaining the knowledge which we seek. Dwelling in the depths of the ocean, or shunning observation in their favourite haunts in lakes and rivers, they perform, unseen for the most part, the functions of their being, so that there may be numerous species whose very forms are yet unknown. Our philosophers, moreover, as Goldsmith complained long ago, instead of studying the nature of fishes, have too often "employed themselves only in increasing their catalogues, from which all that results is but an additional tax on our memory." The amount of philosophic ignorance regarding the generation of fishes is curiously illustrated by the fanciful notions which have prevailed as to that of eels. Aristotle believed that they sprang from mud; Pliny maintained that they were propagated by fragments separated from their bodies by rubbing against rocks. Helmont asserted that they came from May-dew, and gives this whimsical recipe for their production: "Cut up two turves, covered with May-dew, and lay one upon the other, the grassy sides inwards, and thus expose them to the heat of the sun: in a few hours there will be sprung from them an infinite quantity of eels!" Horse-hair from a stallion's tail, and placed in water, used to be considered an unfailing source for a supply of young eels;—a fancy which lingered till the days of our youth, for we remember trying the experiment, and with the most encouraging prospect of success, as we verily believed, when the horse-hair in the water really did begin to move!

While philosophers have thus imposed for a time on public credulity, the general ignorance regarding fishes has been greatly maintained by the prejudices of fishermen, and the incapacity of

so-called "practical men" to observe accurately and reason justly on matters with which they are conversant. From the report of a parliamentary committee we learn that a tacksman of very extensive fishings actually mistook the tape-worm (a mischievous parasite infesting certain portions of the intestinal tube of the salmon) for the food of the salmon. Another "practical man" declares that the digestion of this fish is so rapid, that "fire or water could not consume quicker."

Of the ability of a fishmonger to edify the public as to the habits of the creatures which he is daily handling, we lately fell in with an amusing instance. An ancient dealer in fish, either a wag or an *ignoramus*, gravely informed the writer of "A Morning Visit to Billingsgate," recently published in *The Leisure Hour*, a meritorious production of the London Tract Society, "that salmon-fry are developed from the egg in forty-eight hours, during which time the breeding-bed is anxiously watched by the parent fish, which, immediately on the appearance of their young, conduct them to the ocean with the tenderest care!" This, it seems, is the London fishmonger's version of the now exploded notion that salmon-fry become smolts in about three or four weeks after birth, and migrate to the sea.

It must be owned, however, that the difficulty attendant on all ichthyological researches is increased, in the case of the salmon, by its characteristic habit of annually migrating from its native river to the rich feeding-grounds of the ocean. In writing the life of a salmon we may almost be said to write two biographies; so different in habits and appearance is the salmon at sea from the salmon in the river. In the former he feeds like a glutton, in the latter he is so abstinent that food is hardly ever found in his stomach. With its ocean haunts and modes of living we are still most imperfectly acquainted; but recent discoveries and observations have removed the mystery heretofore resting on its river life, and enabled us to watch the singular process of its generation, from the extrusion of the egg from its parent's body until the little fish assumes the characteristic signs of the salmon, and takes its first departure to the sea, soon to return astonishingly grown, and become a coveted article of human food.

On account of its value—for Franklin truly described it as "a bit of silver pulled out of the water"—as well as because of its most interesting habits, we shall give our readers a brief sketch of its history, and bring under their notice certain important experiments in pisciculture resorted to, in, we think, the well-founded hope that they will ultimately lead to a vast increase in the numbers of the king of fresh-water fishes.

Although capable of living in the sea, and impelled to resort thither once a-year, the salmon is to be regarded as a fresh-water fish. It is born in a river, which it leaves for a sojourn of only

a few weeks in the ocean, from whence, invigorated and ready for the propagation of its species, it returns to its native river with a certainty which has been long known and admired. Hence, when James I. of England meditated a return to his native Scotland, we find him stating that he was "drawn thereunto by a maist saumon-like affection." Looking, then, upon the salmon as a river fish, let us begin our account of its habits with a description of its proceedings at the time and place of pairing.

Salmon prefer a rather cold climate, resorting to the streams when little above the freezing point; and the temperature in which they appear to thrive best is from 40° to 52° Fahr. Their favourite locality in Europe may be reckoned from the Moselle to the arctic circle. The spawning season varies somewhat throughout this extensive region, but in the salmon rivers of this country the variation is inconsiderable. It is believed that spawning occurs, in a few instances, in almost every month of the year; but the time for this interesting operation is chiefly in the months of November and December. Generally speaking, however, the fish are so far advanced in pregnancy as to be unfit for human food by the end of September. In the months above mentioned the salmon are in pairs, and having selected a stream with a gravelly bottom, the operation of spawning may be witnessed during the four, five, to ten days required for its completion—owing to the ova not being ready for extrusion all at the same time, or in consequence of the fish being scared and interrupted in their labours. Mr Shaw and others have maintained that the male takes no part in the toil of forming the spawning-bed. "Ephemera" and Mr Young, in their conjunct and very valuable work, *The Book of the Salmon*, denounce all such as "feather-bed naturalists." Having a wholesome dread of such an imputation, especially from one like "Ephemera," the dictator to the sporting world who swear by *Bell's Life in London*, we, with all humility, receive the account given by him and Mr Young of the manner in which salmon gratify their philoprogenitiveness: "A salmon-bed is constructed thus: the fish having paired, chosen their ground for bed-making, and being ready to lay in, they drop down the stream a little, and then returning with velocity towards the spot selected, they dart their heads into the gravel, burrowing with their snouts into it. This burrowing action, assisted by the power of the fins, is performed with great force, and, the water's current aiding, the upper part or roof of the excavation is removed. The burrowing process is continued until a first nest is dug sufficiently capacious for a first deposition of ova. Then the female enters this first hollowed link of the bed, and deposits therein a portion of her ova. That done, she retires down stream, and the male instantly takes her place, and pouring, by emission, a certain quantity of milt over the deposited ova, impregnates them. After this, the fish commence a

second excavation immediately above the first, and in a straight line with it. In making the excavations they relieve one another. When one fish grows tired of its work, it drops down stream until it is refreshed, and then with renovated powers resumes its labours, relieving at the same time its partner."

This account of the manner in which the ova of salmon are fecundated is no doubt the true one; and yet it is necessary to notice the speculations and experiments of certain recent writers, who maintain that the ova are impregnated while within the body of the female salmon, and by actual copulation with the male. M. Bonnet, the Genevese philosopher, writing in 1781, while modestly confessing that we know very little about the amours of fishes, positively declares, "Le mâle et la femelle sont privés des parties propres à la copulation." * Mr T. T. Stoddart, however, an enthusiastic angler, and a very amusing writer, knows more about the conjugal rites of fishes, and roundly asserts that salmon are provided with copulative organs, which they undeniably use, he thinks. "I hold it," says he, "to be a palpable anomaly that no direct act of coition should be considered to take place betwixt the milter and spawner, and *that* long previous to the effusion of the ova." † Knowing Mr Stoddart to be a poet, we should have taken the liberty of passing by such a specimen of his imaginative faculty; but when Dr Robertson of Dunkeld professes to have demonstrated, by careful experiment, that the ova of trout are impregnated previous to exclusion, we feel bound to attend to the theory of our poetical angler. It is contradicted by the repeated experiments of Messrs Shaw and Young, and still more recently by those of Dr Davy, as communicated to the Royal Society of Edinburgh. All these careful observers declare that not the slightest sign of vitality could they ever perceive in the ova of salmon or of trout, unless previously impregnated by contact with the milt. As to the inaptitude of the organs of salmon for coition, Dr Davy's anatomical reasoning is conclusive.

Dr Davy also points out the probable source of Dr Robertson's mistake, when he fancied that he had succeeded in hatching trout from ova not impregnated by milt. "The box containing them was placed in a stream. What is more likely than that they might have been impregnated—so included, but not insulated—by the spermatic granules, the spermatozoa of milt shed by some fish in the adjoining water? The diffusibility of these living granules—not the least remarkable of their qualities—seems to be favourable to this conclusion."

In confirmation of Dr Davy's supposition that the ova of the trout deposited in the stream were accidentally impregnated by floating particles of spermatic fluid, we recall the singular experi-

* *Œuvres*, tome ix. p. 287.

† *Angler's Companion*, p. 189.

ment of Spallanzani in artificially fecundating the ova of toads. He found that to touch them once with the point of an extremely fine needle was enough to render them prolific. Until, therefore, the ova of trout or salmon are fertilised under circumstances rendering the access of the smallest portion of the male sperm impossible, we cannot attach importance to the theory of Mr Stoddart, or to the unsatisfactory experiments of Dr Robertson.

The ova, then, of the salmon being deposited, after impregnation in the manner described, we have now to trace the process of their vivification. Of this we are not aware that we have any detailed and perfectly trustworthy account until the publication, in 1843, of *Observations on the Natural History of the Salmon*, by Robert Knox, F.R.S.E. While cheerfully acknowledging the great value of these observations, justice requires us to record that this skilful anatomist and careful observer sanctioned, and still sanctions, the mistaken idea that, in three or four weeks after exclusion from the egg, the young salmon assumes the silvery aspect of the smolt, and migrates to the sea. For the rectification of this, until lately, general belief, we are indebted not to a man of science, but to Mr Shaw of Drumlanrig, forester to the Duke of Buccleuch. We avail ourselves of the information first communicated by him, and afterwards confirmed by the experiments of Mr Young of Invershin, manager of the Duke of Sutherland's salmon fisheries.

The quantity of ova deposited by the salmon, though by no means so great as that of many fishes, is nevertheless very considerable. Those of a grilse of 8 lb. amount to about 8000, while those of a salmon of 25 lb. have been found to be nearly 25,000. The period during which they remain under the gravel varies with the temperature of the water in which they are placed. Ova deposited in September, when the temperature is high, will produce fry in 90 days; while those deposited in December may remain unproductive till the 140th day. In the artificial breeding-ponds of France the ova come to life in 60 days, whereas in Perthshire the earliest have not appeared till 120 days. A gentleman at Perth, however, having deposited ova under a spring flowing from a rock at Barnhill, the fry came into life, some in 50, and others in 60 days.

The ovum, on its extrusion from the salmon, is of a pale blue colour, and about the size of a small pea. It is composed of a white shell and light red yolk. On the 20th day after being deposited in the gravel, a very small but brilliant spot appears on one side of the yolk, and this brilliancy increases daily until, on the 48th day, it covers more than half the yolk, and still continues spreading. On the 48th day the young fish make their first appearance in the form of a bluish white thread in the yolk of the egg. On the 63d day this formation is furnished at one end with two very small black spots—the eyes of the future fish. After

this there is a decided daily change, until the 93d day, when the eyes are more distinctly seen, and the head also is apparent; the red of the yolk is drawn more closely towards the belly of the fish, where it is formed into a conical bag, one end of which is attached to the fish. This singular appendage is better seen on the 100th day, when the motion of the embryo, and of the attached bag, may be leisurely examined, by taking an ovum, with a little water, into the hollow of the hand. The heat of the hand, raising the temperature of the water, causes immediate activity in the fish; and the whole of its structure and rapidly advancing changes may be daily watched. The restlessness of the little prisoners increases day by day until the 135th day, when the whole spawning-bed is in lively commotion, and very many of the fish, having so far made their escape as to liberate their tails, the bed resembles a thick braird of grain. The coiled-up fish breaks his cell by his efforts to straighten himself, the rupture being always effected opposite the back fin. The conical bag and the head remain in the shell a little longer; but the efforts of the fish, aided by the stream, soon effect a perfect liberation, and the newly-born fish are before us, of the average length of three quarters of an inch.

Instead of being a handsome little creature, such as we might fancy an infant salmon, it has an ungainly tadpole-like appearance, and, though rapid, is unsteady in its movements, owing to the disproportionate size of its head, and of the large heart-shaped bag still attached to its belly. Finding itself unable to swim while hampered with this appendage, fully a quarter of an inch long, and as bulky as all the rest of its body, the little creature, when disturbed, instantly darts under a stone, as a protection at once from the violence of the stream and from the voracity of its enemies. We should describe this movement as a rapid wriggle rather than true swimming. It answers its purpose perfectly, however, for it is out of sight in a moment. This protuberant bag is a singular provision for supplying it with food for the first five weeks of its existence, during which period it takes no external nourishment. Its contents being consumed, it disappears; and the fringe-like fin, hitherto surrounding the fish, gradually vanishes, and is succeeded by the true fins in their proper places.

At the age of two months the fry are distinctly marked with those transverse bars which used to be considered the characteristic of a different species of fish—the parr, which, however, by the experiments of Mr Shaw, is now demonstrated to be the young of the salmon; or, to speak more correctly, the little fish generally termed parr is now shown to be the young salmon. We make this correction out of deference to those who, like Dr Knox, Mr Young, and others, maintain that there is what they term a parr-trout—an adult, as they conceive, of the river-trout species. The alleged fact of the existence of such a species of trout can only be set at

rest by the production of a female with well-developed roe. Such a female is said to have been seen; but, considering "the extreme rarity of such a phenomenon," we agree with Dr Knox that "it would have been desirable to have preserved the specimen, and submitted it to scientific men." In the mean time, all that is known about parr may be found recorded in an important chapter of Dr Knox's recently published little work, *Fish and Fishing in the Lone Glens of Scotland.* Personally we never saw, nor have we ever met, any one who has seen a female parr with well-developed roe. And Mr Ffennell, one of the inspecting commissioners of the Irish Board of Fisheries, writing to us last November, declares that he has not been able to procure such a parr, though he has been in search of it for years, and has employed others in the search, and offered a high premium for the fish in the desired condition.

As the distinction betwixt the young salmon in the parr-like state and the so-called trout-parr is not obvious to common observation, the prudent course is to regard them as identical, and to preserve them with the utmost care. Considering that twenty years have elapsed since Mr Shaw demonstrated that what is commonly called parr is in truth a young salmon, it is marvellous that the proprietors of salmon rivers should so carefully watch over the young salmon during the two months when they chiefly assume their silver coats, but permit for ten months in the year the unrestricted slaughter of parrs, which, notwithstanding the existence of the very similar parr-trout, ought assuredly to be considered as the young of the true salmon. If our national custom was to commit infanticide without remorse or legal hindrance, until our younkers were approaching puberty, and if the law were to denounce as murder the slaying of youth or maiden of about the age of fifteen, we should have a parallel to the piscatorial folly of permitting the slaughter of parr, but legislating stringently against the capture of smolts.

A very interesting controversy is still going on as to the precise time when the parr assumes the silvery coating of the smolt, and makes its first migration to the sea. Mr Shaw, we believe, is still of opinion that this, with a few exceptions, does not occur till the conclusion of the second year. On this important point he differs with Mr Young, and also with Mr Gotlieb Boccius, who, after ample experience, speaks thus positively: "When a smolt is a year old, nature begins to cover it with a second lamination under the first scales, and thus covers the bars. It then shows a desire to migrate; but the migration to the sea cannot take place until the second formation of the scales has been perfected, by means of which new envelope its body is protected from the increased density upon the removal from fresh water to salt. It has been fully ascertained, that when fry without the second lamination, or

under a year old, have been placed in salt water, they immediately die."

The determination of the time when the parr assumes this "second lamination" became in May 1855 a question of practical importance, demanding immediate solution. At that date the salmon-fry reared in the breeding-pond at Stormontfield, near Perth, had attained the age of nearly fifteen months. Those interested in this great experiment had therefore to make up their minds as to whether they were to be dismissed from the pond, in conformity with the experiments of Mr Young, or retained for another year, as advised by Mr Shaw. The late Mr James Wilson, the well-known naturalist, Mr Shaw, along with Lord Mansfield, Dr Esdaile, and several others, met at Stormontfield on the 2d May 1855, in order to decide what should be done with the imprisoned fish. We give the result in the words of Mr Wilson: "The only example of a smolt exhibited to the meeting throughout our careful inquiry and investigation, was one caught by Dr Esdaile while angling in the river Tay. He brought it to us immediately; and when set alongside the parr from the pond, its greater size and spotless silvery lustre made its difference obvious to all. The meeting came to the distinct and unavoidable conclusion that the inhabitants of the pond *were still parr;* and Lord Mansfield especially, and very properly, pressed for their being detained in confinement another year, for the sake of a complete and conclusive experimental demonstration that these so-called parr take two years to become smolts. Their continued captivity was therefore determined on."

The holders of the biennial theory had thus a complete triumph. It was but of short duration, however; for, in a letter published 21st May, Dr Esdaile wrote thus: "On the 19th May, seventeen days after Mr Shaw's visit, I revisited the pond in company with a number of experienced fishermen and anglers, and out of about a dozen fish caught by me with the fly there were five unmistakable smolts, not to be distinguished from the smolts caught in the river at the same time. Many other smolts were also taken with a very imperfect net, so that there must be many hundreds, or even thousands of exceptions to Mr Shaw's rule in the pond already, and as the weather becomes warmer, the conversion of the fish will doubtless be proportionably increased." These facts becoming known, the tacksmen of the Tay fisheries presented to the proprietors of the fishings a memorial, in which they express it as their "decided conviction that all the young fry should, on as early a day as possible, be turned out into the river, to join their fellow-smolts now on their way to the sea. But," they reasonably added, "we have no objection that a portion of the young fish be retained in the ponds to test the correctness of the views of those who maintain that they ought to remain two years, it being our anxious wish that

this interesting experiment should have a fair trial, and every fair play."

In consequence of this representation, the fry in the pond were permitted to enter the river on the 29th May, care being taken to mark about 1300 by cutting off the adipose or dead fin, for the purpose of recognising them on their speedily anticipated return from the ocean.

The result shall be related when we have finished our sketch of the life of a salmon. Their progress to the sea was, it may be presumed, not unlike that of a migration thus described by Mr Shaw, from personal observation: "They passed down the river in small family groups or shoals of from forty to sixty and upwards, their rate of progression being about two miles an hour. The caution which they exercised in descending the rapids they met with in the course of their journey was very amusing. They no sooner came within the influence of any rapid current than they in an instant turned their heads up the stream, and would again and again permit themselves to be carried to the very brink, and as often retreat upwards, till at length one or two bolder than the others permitted themselves to be carried over the current, when the entire flock disappeared; and then, as soon as they had reached comparatively still water, they again turned their heads towards the sea."

Arrived at the ocean, they find that the Power which led them thither has made a bounteous provision for their wants in the eggs of various species of echinodermata, together with the smaller crustacea. Returning to the river in six or eight weeks, their increase in size is proved to be astonishing. To Dr Esdaile we are indebted for the following interesting memorandum, demonstrating this in the most satisfactory manner:—

"No. 1 is a young salmon, 15 months old, from the artificial breeding-beds and rearing-pond at Stormontfield, killed 29th May 1855; length, 5 inches; circumference over dorsal fin, 2 inches; weight, ½ an ounce. No. 2 is a fish of the same age, dismissed from the rearing-pond on the same day, after having the dead fin cut off. It was taken by the net three miles below Perth on the 19th July, having been absent 51 days: length, 24⅝ inches; circumference over dorsal fin, 12½ inches; weight, 5½ lb."

Next season this weight will be doubled; but being ignorant of the extreme limits of the natural life of the salmon, we know not how long this increase may continue. The age of a fish has hitherto been difficult to ascertain, but Mr Boccius asserts that by means of the microscope he has discovered that the laminations of the scale are readily detected, and that these denote the age the same as the rings on an oyster shell. This seems to be an old idea, for we find Mr Fraser, in his natural history of the

salmon, referring to Buffon as "examining the scales of a carp for the purpose of ascertaining his age, and finding him to be no less than 100 years old."

Salmon, however, have their troubles, and while revelling in the abundance of their sea-quarters make dainty fare to the nimble porpoise and the voracious seal. While dwelling in the sea, they are also exposed to the minor misery of attacks by the parasitic insect popularly known as the sea-louse. They thus find that getting fat is not a sufficient compensation for being daily frightened and tormented; and, we presume, this sad experience helps their instinctive impulse to return to their native river. Their invariable return to their native streams is abundantly authenticated; the fish of each river have also such distinguishing characteristics that experienced observers will at once say, for example, "*That* is a Tay fish, while *this* is from the Isla." A fish produced in the Isla will come up the Tay, passing in its course the Erne and the Almond, and in the Isla

"Repeats the story of her birth."

Nay more, if produced in some of the streams falling into Loch Tay, it will pass we know not how many small rivers, and through the loch into the particular stream for which it seeks.

When Ovid (1. *De Ponto*) thus mourns the exile's fate, he was in truth describing salmon—

"Nescio qua natale solum dulcedine cunctos
Ducit, et immemores non sinit esse sui."

Knowing that a single salmon produces, it may be, twenty-five thousand ova, and that, according to a very moderate computation, one hundred million are annually deposited in the Tay, we are apt to be surprised at the complaints as to the decrease of salmon, not in this country only, but also in Norway, Holland, and the United States of America. But our surprise disappears when informed that the salmon annually captured in the Tay are as one to a thousand of the deposited ova. It is scarcely within the power of human ingenuity sensibly to diminish the finny tribes inhabiting the sea. And yet the whale—

"Leviathan, which God of all His works
Created hugest that swim the ocean stream"—

has by man's incessant pursuit been driven so far within the regions of "thick-ribbed ice," that whale-oil, to the great joy of gas-companies, is annually becoming dearer; and ere long whalebone may be so costly that, in answer to the question, "What's the use of whalebone?" we may never again receive, from a boy in a Scottish parochial school, the ready reply, "Our *mithers* put it in their breasts."

But a fish alternately dwelling in the ocean and the river is so much within the reach of human destructiveness as to require artificial protection. We therefore look with interest and hope on the proceedings of those who, in Germany, Sweden, England, France, Ireland, and Scotland, are engaged in what, absurdly enough, is termed the *artificial propagation* of the salmon. This absurdity is amusingly seen on the title-page of Mr Ramsbottom's interesting pamphlet, which exhibits "a specimen of a young salmon taken from those sent to the Dublin Exhibition, and *propagated by the author!*" All that is artificial in the matter is the application of human fingers to the belly of a parturient fish, the placing of the expressed ova under gravel in a current, the confinement of the fry till the time of migration, and the feeding them on sheep's liver and occasional maggots, as at Stormontfield, or upon nothing but water, as recommended by Mr Boccius.*

For this happy idea we are indebted to the German naturalist Jacobi. Observing how flowers are impregnated by the fertilising dust being conveyed by winged insects lighting on them, it occurred to him that, in like manner, the prolific seed of one living creature could be artificially transferred to another. In 1758 he artificially impregnated trout and salmon ova. Taking the female fish when her ova were mature, he gently pressed them out into a vessel ot pure water, into which, in like manner, he immediately introduced the milt of the male. Amongst the most curious of his discoveries must be reckoned his demonstration of the fact that eggs taken from a fish four or five days dead, and actually putrid, could be impregnated as successfully as those taken from a living fish. Practically applied, as Jacobi's experiments were to a considerable extent, they were apparently forgotten, when in 1849 the attention of the government of France was attracted to the labours of two humble fishermen, Géhin and Rémy, who, by the same method practised by Jacobi, and more recently by Mr Shaw, had succeeded in stocking the tributaries of the Moselle with millions of trout; the ova, in some instances, having been transferred from distant rivers celebrated for their superior breed of fish.

Such results attracted the notice both of the capitalists and the lovers of natural history in this country. Messrs Edmund and Thomas Ashworth have, by means of artificial fecundation, reared about 260,000 young salmon near Lough Corrib, in Ireland. Their operations trenching on the supposed rights of the squireens, we were sorry to be lately informed that these small gentry had intimated that, unless bought off, they were resolved to hinder the further prosecution of the experiment!

In the autumn of 1853, at the suggestion of Dr Esdaile, the pro-

* This is possible only when the young fish are confined within a large space. At Stormontfield the size of the pond is only a quarter of an acre; and there, we are persuaded, they would have perished unless artificially fed.

prietors of the salmon fisheries on the Tay laid down 1000 lineal yards of breeding-troughs, calculated to contain a million of salmon ova. Owing to the lateness in beginning operations, the boxes were only partly filled, and in May 1855 the breeding-pond was estimated to contain about 300,000 salmon-fry. We have already alluded to the debate as to the time of their dismissal from the pond. We have now to speak of the commercial aspect of the question, and to describe a perplexing anomaly in the history of these little fish.

Of those marked we have undeniable proof that 22 were captured as grilses, weighing from 5 up to 9½ lb. The fish of the last-mentioned weight was taken on 31st July, having left the pond on 29th May, weighing in all probability not more than a single ounce. It has thus been demonstrated that salmon fit for the market can be artificially reared within 20 months after the deposition of the ova. Of the salmon-fry reared at Stormontfield, it is estimated that 2000 have been taken as grilses, and that, valuing them at 3s. 6d. each, their worth was £300. Next year, those captured as salmon will be much more valuable; so that, as a commercial speculation, the experiment will prove remunerating, provided it be carried out on an extensive scale.* The hope of the Tay-fishing proprietors, that their gain would consist of all they could capture of about 300,000 grilses, has been frustrated by an unexpected occurrence. After the 7th June, migration from the pond ceased, and thus there was left in it apparently one half of the fish whose departure and return the same season had been confidently reckoned on. Thus, while one portion of the same hatching was being captured in the river as beautifully grown grilses, another portion was still in the pond, tiny creatures of about three inches long, and not more than an ounce in weight! When we visited them in August, so numerous were they, and so lively their movements, that the surface of the pond appeared to be dotted as it were with drops of rain. They took the fly-hook with the greatest avidity, and having captured one, we found it plump and vigorous, but a veritable parr, totally free of the silver scales of the smolt. At the end of November they exhibited the same appearances. Mr Buist, the intelligent superintendent of the Tay fishings, assures us that "no other fish, nor even the seed of them, could by possibility get into the ponds;" and he also mentions the singular fact, that in these little parr "the males have the milt as much developed, in proportion to the size of the fish, as their brethren of the same age, 7 to 10 lb. weight; while the females have their ova so undeve-

* It will—by the English Salmon Fishery Company, Limited; Boccius' Patent, capital £10,000, shares £1. Having secured all the requisite leases and interests, the company will immediately commence operations on the beautiful river Dart, in Devonshire, which is peculiarly favourable to the lucrative development of Mr Boccius' plans.

loped that the granulations can scarcely be discovered by a lens of some power."

"Piscator," in a communication to the *Scotsman*, dated 1st June 1855, and consequently before he could have known of the refusal of the Stormontfield fry to leave the pond, suggests a novel explanation of the above anomaly. Owing to obstructions, salmon, he informs us, only succeed in depositing their ova in the river Wharfe, in Yorkshire, once in five or six years. The fishermen, therefore, can observe what follows the spawning of a few salmon in any particular year, without being misled by having fry of different years mixed together. "During the first summer they find in the river small parrs, which in autumn are of two perfectly distinct sizes." This disparity has been noticed at Stormontfield throughout the experiment, and has excited much surprise. In the following spring, generally in April, but varying according to the temperature, *the larger of these two species of parr assume the silvery appearance of the smolt, and descend to the sea, leaving behind them all those which were of the second size, and which still retain in perfection the peculiar marking of the parr.* I have caught hundreds of them in and about the month of October, and *have almost invariably found them to contain milt, showing that they were male fish.* The necessary inference from this fact is, of course, that those which had descended to the sea during the previous spring were females. These male fish, during the following spring, generally about the beginning of March, assume the blue and silvery appearance of the smolt. Let the inmates at the pond at Stormontfield be carefully examined. No doubt some few will still be left there. Let one or two of them be examined anatomically to determine their sex. Let the same be done with some of those which now retain, *and if my theory be correct, will be found to retain, all the summer, the appearance of parrs.*" The portions of this letter which we have printed in italics, are so much in harmony with the results observed at Stormontfield, that very possibly it may turn out that the anomaly there noted may find its solution in the demonstration of the fact, that female salmon-fry descend to the ocean a year earlier than the males of the same brood.*

A deputation of naturalists is expected at Stormontfield; we wait the result of their examination with much interest. In the mean time we record the fact that, during last season, both male and female grilses and salmon were caught bearing the Stormontfield mark. It already is evident, however, that the opposing views of Messrs Shaw and Young are partly right and partly wrong. It is not true that only a small portion of salmon-fry

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* Facts, communicated by Mr Buist and another friend in Perth, now authorise us to assert that "Piscator's" theory is contradicted by the careful observations of the Perthshire pisciculturists.

become smolts at the end of their first year, as Mr Shaw supposes; neither do they all become so, as Mr Young confidently asserts.

From Mr Shaw's admirable memoir "On the Growth and Migration of the Sea-Trout of the Solway,"* we learn that, at the age of twenty-four months, three-fourths of the brood of that fish assumed the migratory dress, and that this was not assumed by the remaining fourth, which he maintains do not migrate, but permanently reside in the river; the females maturing their roe sufficiently to reproduce their species with young males of corresponding age. A writer in *The Edinburgh Review* (July 1843), having referred to the sea-trout permanently resident in the island of Lismore, Argyleshire, and to those which for nearly twenty years have bred in the Compensation Pond near Edinburgh, thus proceeds: "We venture to state that this same power of adaptation to fresh water is possessed by the salmon;" and having referred to Lloyd's *Field-Sports in the North of Europe*, to prove that the 21,817 salmon caught in Lake Wenern in 1820, of the average weight of six or seven pounds, but never above twenty, "could never have been in the sea," the reviewer proceeds: "It is probable, indeed—and we beg to call Mr Shaw's attention to the probability—that a certain portion of the salmon-brood may, like the sea-trout, remain permanently in our rivers." It remains to be proved, we observe, that these so-called salmon in Lake Wenern are true salmon. The probability suggested may, by the experiment at Stormontfield, turn out to be a reality; and in that event, the question will arise whether the non-migration of the fish there reared be natural to the species, or the result of the circumstances in which they have been placed. It is conceivable that a young salmon, regularly fed, may have its craving for food so abundantly gratified as not to feel the instinctive longing which impels its unpampered congeners to make for the feeding-grounds of the ocean. Such a result may have important consequences. If fishes, naturally migratory, can be so treated as to convert them into permanent dwellers in our lakes and rivers, we shall be great gainers by restraining their vagrancy.† If we place them in accessible positions, where at any time we can lay our hands upon them; if we secure them from the attacks of otters, seals, and porpoises,—we may, in almost every country, have lakes like Lake Wenern, yielding thousands of valuable salmonidæ, if not true salmon. In Scotland we have about 180 miles of canals. Why are they

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* *Transactions of Royal Society of Edinburgh*, vol. xv, part iii., p. 369.

† The Irish Board of Fisheries transferred artificially-reared salmon-fry to a sea-pond at Kingstown, in the hope of raising them to maturity. They increased in size, but gradually disappeared, having been devoured by crabs, conger-eels, or water-rats, with which the place was infested. Mr Ffennel informs us that he will repeat the experiment under more favourable circumstances, and is confident as to its success.

fishless, when they might be easily stocked with many valuable species of fish? Why do the Water Company, owners of the Compensation Pond among the Pentland Hills, not encourage the breed of so valuable a fish as the sea-trout? Why not try to swell their annual dividend by the introduction into their capacious reservoirs of the species of salmon so abundant in Lake Wenern? In order to induce a private proprietor to do what a water company may not have the spirit to attempt, we suggest a locality admirably suited for the experiment.

If our readers have ever travelled by rail from Edinburgh to Perth *viâ* Fife, they doubtless remember the little Loch of Lindores, when approaching the estuary of the Tay, and at the distance of two or three miles from Newburgh. Within half an hour's journey from the populous towns of Perth and Dundee, and distant from Edinburgh and Glasgow not more than two and four hours respectively, such a locality has every advantage for carrying out the experiment we suggest. Should our hint be taken, and should Cardinal Wiseman, in a year or two thereafter, chance to travel that way on a Friday, we venture to promise him such a fish-dinner as shall make it easy for his Eminence to observe the dietary of the church.

As a further encouragement to those who may be alarmed at the cost of breeding-boxes, we recommend the very ingenious and most useful patent fish-breeding apparatus of Mr Boccius, of whose labours in stocking the whole course of the river Itchen, in Hampshire, with various kinds of fish, we trust soon to receive the published account. It is made of gutta-percha; and one capable of containing 25,000 salmon ova is only two feet long by one broad, and requires four inches depth of water. The cost is £10, 10s.

What more can the lovers of pisciculture desire, save an abatement in the price? Here is an apparatus so neat and handy that it may be placed on a small table in a drawing-room. In many a house where there is a supply of pure water, we anticipate that bright eyes will watch the evolution of the salmon from the ova, and that the name of Boccius will be familiar as a household word. As a result of this attention to pisciculture, it may be reasonably hoped that our rivers shall teem with the noble salmon; that our lakes and streams shall be stocked with the choicest kinds of fish, whose ova can be transported from foreign waters;* and that

* We recommend the introduction of the black bass from Canada or the United States of America, because a delicious fish, which, moreover, does not migrate to the sea. "This is one of the finest of the American fresh-water fishes. It is surpassed by none in boldness of biting, in firm and violent resistance when hooked, and by a very few only in excellence upon the board. It bites ravenously at a small fish or minnow tackle, and also affords excellent sport with the artificial fly. It attains the weight of 6 or 8 lb."

grateful additions shall be made to the limited fare of the great body of the people. In those anticipated days, when fish shall be reared by millions, how many a keen angler, who now only gets "glorious nibbles," shall experience the frequent joy of slaying a plump five-and-twenty pound salmon fresh from the sea, with the sea-louse yet clinging to his silvery sides! And how shall his heart beat against his ribs as the noble fish springs yard high into the air, and then dashes madly down the stream, while the reel *birrs* as the line whisks through his almost blistered fingers! If in the plenitude of their piscatorial skill some of our readers have only "dragged an incautious minnow from the brook," they will be amazed to be told that the first capture of a bouncing salmon is an era in the angler's life, and lets him know what stuff he is made of. Why, we have seen a fellow six feet high trembling all the length of him, when first called upon to deal with all the cunning dodges, the hard tugs, the wild springs of a well-hooked heavy salmon. The bodily labour of a prolonged contest with a powerful fish is far from inconsiderable. To follow him for a couple of hours, perhaps, along the wild banks of a roaring river, sometimes running, often wading, and it may be stumbling over the smooth stones, is exercise calling into vigorous play the muscles of the back, arms, and legs, and affording such excitement to the mind, moreover, that we do not wonder at the enthusiastic declaration of Mr Younger, the well-known angling shoemaker of St Boswell's: "It beats Grecian games, as well as English horse-racing and hound-coursing, all to nonsense: for of all earthly recreations, that of a start for a day along a fine trouting stream, by grassy bank and alder copse, with the excitement of having something to pursue as an object of exercise, has a perfect charm in it, giving a refreshing relish to the existence of the recluse of art, or the son of craft, shut up the year long in the stalls of labour, where even a rat, though fed to the full, would tire, and eat his way out through a deal board!" We look upon outdoor recreations for the labouring classes as deserving of all encouragement; and when streams and canals, lakes and rivers, come to be amply supplied with variety of choice fish, we hope that proprietors of fishings will throw them open to all rod-fishers every Saturday throughout the

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"The rock bass, which only attains a weight of from 1 to 2 lb., might also with great ease be transplanted into our inland waters; and as they are hardy, and would be sure to thrive, would prove delicious additions to our lacustrine species of fishes." "The striped bass is properly a sea fish, which in spring ascends the American rivers for the purpose of spawning. It sometimes is caught of the weight of 70 to 80 lb. The smaller fish of 7 or 8 lb. are by far the most delicate, and afford most sport to the angler. It is one of the most beautiful and excellent of American game-fish, the flesh being firm, white, and well-flavoured."—(See *Fish and Fishing of the United States*, by H. W. HERBERT.)

The ova of all these can easily be transported to this country. Mr Boccius is sanguine that this year he will succeed in transporting salmon ova to Australia.

season, in compensation for the rigorous preservation of the parr. The people's natural love of sport will thus be gratified without incurring the stigma of poaching; and all classes having an interest in the preservation of the fish, they will be allowed to breed unmolested. It will be reckoned shameful to kill them out of season; and public opinion being on the side of the law, no mercy will be shown to the poacher who spears or nets salmon on the spawning-bed; so that never again shall we hear of a merciless slayer of mother fishes confessing before a parliamentary committee that, at one hauling-place on the Tweed, his brother one night netted upwards of 400 spawning salmon and grilses; which, we add for the gratification of our Scottish friends, were sent to Edinburgh as *kippers*,—the red colour, which looked so charming, arising from the liberal use of saltpetre!

NOTES ON NOVELTIES AT THE SMITHFIELD CLUB SHOW.

By R. Scott Burn.

In the two previous Numbers we presented our readers with a few notes on the Agricultural Implement Department of the Sydenham Crystal Palace, describing more particularly the "novelties" in agricultural mechanism there exhibited. As supplementary to these chapters, we now propose to devote a few pages to the description of still more recent novelties, introduced to the public through the auspices of the Metropolitan Show above noted. Judging from the immense crowd which thronged the too confined galleries during the four days in December last in which the Show was held, there seems to be little ground for complaint of want of interest in agricultural exhibitions—we mean popular interest; for it was by no means a difficult matter to distinguish those possessed of the professional look peculiar to persons directly interested in farming, from those who belonged to other callings, and who formed, evidently, no small proportion of the thronging crowds. Whether brought there from real interest in the matter, or from a desire to obtain that excitement which so distinguishes a London crowd, we do not now pretend to say. And of the two departments, the "Fat-Cattle" and the "Implement," the marked difference shown by the crowded state of the one, and the comparatively deserted condition of the other, indicated the high estimation in which the latter department was held. Nor was it less gratifying to be made acquainted with the fact, that a large amount of business was done, in "orders taken," by some of the largest firms, as well as by less noted agricultural implement makers; thus showing that farmers, the "slowest of the slow," as certain folks

delight to call them, are not always dead to the important aid which mechanism is so well calculated to give them.

In presenting our "Notes" on the "Novelties" of this very successful exhibition, we propose, as closely as we can, to describe the implements in the order of their use; that is, to commence with the field implements, and finish with the standing or house machines.

Although an excellent assortment of the well-known ploughs of Howard, Ransome, and Sims, Bushall, Busby, &c. &c., was exhibited, they claim from us at present no remark, our attention being devoted to a notice of the novelties only. In this department little has to be said, for only one novelty was exhibited, named by its inventor and manufacturer, Joseph Warren of Maldon, Essex, the "Patent Expanding Plough," and this from "a novel action introduced into the framework, whereby the plough and share are easily adjusted with a hand-lever to take more or less depth of earth, and to insure its running level with greater ease for the horses, and less trouble for the ploughman to guide." It is not always a safe way to judge of the merit of anything simply from its appearance; and this apparently holds true of this novelty, as, notwithstanding its somewhat clumsy appearance, from the numerous testimonials in its favour from practical farmers, the patentee seems fairly entitled to claim for his invention some degree of attention to it as an efficient implement. We are nevertheless inclined to think that its "efficiency" would be greatly enhanced by more attention, on the part of the manufacturer, to the constructive details. Bulk of parts does not always insure strength, nor complexity of details perfection in a simplicity of action—points, be it noted, which many of our agricultural implement makers are too apt to lose sight of. In this same, as in other exhibitions, we saw numerous instances of forgetfulness of those points; while, on the other hand, it was gratifying, in the works of our most celebrated firms, to see how much was effected in the saving of material, and in securing strength, from a knowledge of the laws regulating the strength of materials and the construction and arrangement of mechanism. But to return after this digression—not altogether unsuggestive, be it hoped. The next novelty in field implements we have to notice, is "Hanson's Potato-digger," manufactured and exhibited by Mr Colman of Chelmsford, Essex. This machine is capable of raising—drawn by a pair of horses—"in a day, an extent of ground equal to that which a pair of horses can form into drills in the same space of time. The potatoes are raised without receiving the slightest injury." The essential parts of the machine consist of a flat broad share and revolving forks. The former is attached by a "sock" capable of adjustment to the framing; this share goes under the potatoes, effectually breaking up and pulverising the soil, and

freeing the potatoes from the drill. In close contact with the upper surface of the share, a series of two-pronged forks revolves. These, eight in number, project from the periphery of a disc, which receives motion from the driving-wheels of the machine. The shaft of the digger-disc is placed transversely to the length of the share. As the tendency of the revolving forks is to throw up or scatter the potatoes to a considerable distance, a strong netting is attached to the side opposite to that at which the sock of the share is fixed. The potatoes, as they are thrown up, are arrested by this netting, and are laid along the drills in regular rows. From a report of a trial of this machine at Mr Renwick's farm, Maryhill, it appears that "the roots were scattered clearly above the ground, over a breadth of two yards. Not a single root was cut or injured in the slightest degree, and none were left in the ground." Not the least important feature of the machine is the ease and uniformity with which the manure is mixed with the earth, and the roots and weeds brought to the surface by its means.

In the department of "Drills and Manure-distributors" one or two novelties were exhibited, which we proceed to notice. Messrs Reeves of Bratton, Westbury, Wilts, exhibited Chandler's "Lever Press-wheel, Dibble, or Drop-lever," possessing considerable novelty of details. Instead of a coulter which cuts the furrow, a "press-wheel" is substituted; this works in a lever, which is weighted at its extremity as the coulter-levers in the ordinary drill or sowing machine. This substitution of the press-wheel for the coulter is assumed by the patentees to be possessed of considerable advantages, as by its use the soil is made firm to receive the seed, and fine on the surface. In consequence of these qualities not being attainable by the coulter, many crops of turnips, they remark, on hollow loose soil, have been entirely lost, or have come up weakly. The wheel-track thus made is particularly adapted for liquid-drilling—much of the success of this system depending on the solidity of the ground on which the liquid falls preventing it from too quickly percolating the soil and leaving the seed.

The seed is deposited in the wheel-track in a continuous line, or in detached portions, in the manner performed by the "dibbling machines." This continuous or alternate deposition of the seed is effected by a very ingenious arrangement. To the face of the press-wheel (*a*), which precedes the "seed-dropping apparatus," a series of snugs or projections (*b*) are attached. To the bar supporting the seed-depositor, and the bearing on which the press-wheel revolves, a stud or standard (*c*) is bolted. This supports at its upper extremity a bolt on which a lever (*d*) vibrates. To the short end (*e*) of this, a rod (*f*) is attached, and is connected with a cylinder (*g*) revolving in the box of the seed-depositor. In the periphery of this cylinder triangular recesses (*h*) are cut, into which the

seed is deposited as the cylinder revolves, the seed passing from the receiver above through a tube after the manner of the ordinary drills. As each recess (*i*) passes into the open space of the lower aperture of the seed-depositor, the seed contained in it is released, and drops into the furrow made by the press-wheel. The long end (*i*) of the lever (*d*) comes in contact with the snugs or projections on the face of the press-wheel; and a spring (*k*) is provided, which brings the lever into its proper position after being acted upon by the stud. The action is as follows: As the press-wheel (*a*) revolves, the projections (*b*) take hold of the long end (*i*) of the lever (*d*), and, raising it, depresses the short end (*e*) and the rod (*f*); this moves the cylinder (*g*) round one space or recess, and allows the seed to be deposited in the furrow; the spring (*k*) forces the lever into its primary position, ready to be acted upon by the next snug brought round by the revolution of the press-wheel. The number of movements of the seed-cylinder, and the consequent distance between each bunch or deposit of seed, is thus regulated by the number of studs in the press-wheel.

In Chandler's Liquid-Manure Drill, to which this new "dropping apparatus" is attached, the supply of liquid manure is maintained in the tubes by a series of buckets, which raise it from the reservoir or cistern, which is divided into compartments to suit side-hill lands. The buckets are fixed to the cylinder by bolts and screws, thus avoiding the loss by friction, and the wear and tear of cups and chains.

Messrs Garret & Co. of Saxmundham exhibited one of Chambers's "Broadcast Manure Distributors," a machine which possesses a high reputation—indeed, we may say the highest. It is capable of regularly distributing the most difficult manures—such as guano, blood-manure, salt, nitrate of soda, &c.; and can sow from 2 to 100 bushels per acre, as required. The following is the patentees' description of this machine: "A hopper for carrying the manure is mounted upon wheels, and is arranged with shafts or apparatus for attaching a horse or horses. Exterior of the hopper, and near the bottom thereof, is arranged a cylinder, which I prefer to be composed of numerous short cylinders, each having three or other convenient number of inclined blades protruding a short distance from its periphery; the distance of such protrusion of the blades being capable of adjustment, in order to regulate the quantity of manure thrown off. The protruding blades of the succeeding short cylinders are not set in the same line, but at intervals apart; and the quantity of manure allowed to flow out at the bottom of the hopper, so as to come on to a curved incline, to be acted upon by the blades, is regulated by a slide. The cylinder receives motion from a cog-wheel fixed on one of the wheels on which the machine is carried; and the speed at which the cylinder revolves is regulated by changing the sizes of the

wheels, which are used respectively on the axis of the cylinder, and on one of the revolving wheels. Below the bottom of the hopper is a bar having several blades or projections, which pass through an opening at the bottom of the hopper, and which, by a to-and-fro motion, insures the lower part of the manure being broken up near the opening-out of the hopper, so that a constant flowing out of manure will be insured, which, falling on the curved incline over which the cylinder revolves, will be moved and thrown off by the projecting inclined blades on the cylinder. In order to insure that no manure shall adhere to the inclined blades, or the peripheries of the short cylinders of which the cylinder is composed, a series of bent scrapers are mounted on an axis below the axis of the cylinder—each scraper being pressed up by an adjustable weight to the surface of the cylinder, so that each part of the cylinder, and the acting surfaces of the inclined blades, thereby will be cleansed or scraped at each revolution of the cylinder, and this whether the manure be in a dry or in a moist state."

Messrs Garret also exhibited an improved Water-drill, patented by Mr Chambers. This invention has for its object improvements in agricultural drills, with a view to deposit at intervals, in place of continuously; and the same is applicable when drilling seeds and liquid manure, and also when drilling seeds, water, and manure. For these purposes there is applied a rotating wheel or chamber to each channel or furrow made by the drill. The rotating hollow wheel has spouts at intervals at its periphery. The seed and liquid manure, or the seed, water, and manure, are delivered into the interior of the chamber from the separate compartments of the drill containing them; and they are retained from flowing out, except when, in the rotation of the wheel or chamber, a spout comes to the ground. The axis of the rotating wheels may receive motion by the wheels thereon, which run on the land; and the running wheels may be made to expand or contract to vary the distance at which the deposit takes place from the spouts, or the axis may receive motion by gearing from the drill.

In the Haymaking Machine patented and manufactured by Mr H. A. Thompson of Lewes, there are some novelties of arrangement and principle which are deserving of notice. In the haymaking machines at first introduced, "tedding," or turning the hay completely over, was the only operation intended to be performed by them. Now, however—whether desirable or not we do not now propose to discuss, albeit the necessity for it may be reasonably doubted—another process in hay-making by machine is required, namely, slightly raising from the ground and scattering behind the machine the hay which was deposited by the complete turning-over action of the machine in the first instance. There are thus two actions—one the "forward," in which the hay is lifted from the ground, and turned completely over towards the

back of the machine; the other the "backward," by which the hay thus deposited is thrown back, but only slightly raised, not turned over by the machine. It is obvious that the form of "tine" which is capable of performing the turning-over action of the first movement, will not be well adapted for the more simple operation of the second or reverse action. In the form of tine patented by Mr Thompson there are two teeth—one curved, to perform the "tedding;" and the other radial, to perform the light scattering of the hay when the reverse action is used.

The travelling-wheels and teethed driving-wheels are mounted upon solid axles revolving on adjustable bearings. This arrangement obviates two inconveniences attendant upon some forms of "tedding-machines," in which the travelling-wheels had hollow naves, turning on a hollow pipe or projection on the side of the machine, producing an unsteady motion, and where the bearings, being fixed, no adjustment of the toothed gearing could be made. From the excellent arrangement of its parts, and the attention evidently paid by the patentee to the constructive details, so as to insure lightness with strength, this machine is worthy of notice. We may add that it obtained the first prize—a gold medal and 250 francs—at the Paris Exhibition in 1856.

In the department of machines for the "Preparation of Food of Cattle," a novelty was exhibited by Mr Bentall of Maldon, Essex, in his patent "Root-pulper." In this machine a barrel is provided with a series of knives, or rather teeth, set in a helical form round its periphery; parallel to this, and in close contact, a small diameter worm, or Archimedean screw, revolves, the pitch of this corresponding with the pitch of the helical line formed by the teeth on the large barrel. Motion is given to the worm-screw by a toothed wheel in the shaft of the barrel, working into a frame keyed on to the shaft of worm. As the barrel is small, the teeth pass between the threads of the worm; and the combined action—the tearing of the teeth and the squeezing of the worm-screw of the two—very speedily reduces the roots to a good pulp. Old or broken teeth can be taken out, and new ones substituted, without rendering it necessary to take the barrel out of its bearings. The arrangement seems well calculated to prevent clogging, and keeps the root well up in the proper position to be regularly rasped down.

Mr Bernhard Samuelson of Banbury exhibited, amongst an excellent assortment of gardeners' turnip-cutters, a new patent "Combined Machine" for grating roots and cutting chaff, and is designed to meet the wants of agriculturists using a mixture of roots and chaff. As these are cut, they are intimately mixed, and are passed through the same spouts. The two portions—the chaff-cutting and turnip-grating—"are arranged so as to be easily disconnected and thrown into gear again by any labourer, so that the

implement possesses the advantage of two separate efficient machines at much less cost; of mixing the food more thoroughly than can be done by the hand or the fork; and (if driven by power) requires the driving arrangements of one machine only—thus saving the cost of a set of driving apparatus. A man and a boy will do 100 bushels of mixed food per hour." Such are the advantages attendant upon the use of the machine, as stated by the ingenious inventor; but it appears to us that the machine wants a power of adjustment, by which the requisite proportions of the materials used can be passed through it, to meet the requirements of a variety of cases; for it is evident that a mixture which would suit the wishes of one feeder, might be opposed to those of another. If this adjustment could be given to the machine, it would doubtless be an exceedingly useful one. A rough adjustment is, however, obviously within the reach of the operator, by only feeding that portion of the machine from which the most material is required. Thus, if more turnips than chaff is required, the turnip-chopper can be fed while the straw or hay trough remains unused, and *vice versa.*

In this department, Mr Patterson of Beverley exhibited his new Roller Mill for crushing, grinding, and shelling various kinds of produce. In this machine the rollers are placed in such a manner that the axis of one roller-shaft is in a different plane to the other, thus producing a compound or wrenching action in grinding. The distance between the rollers, and the consequent fineness of the material which passes between them, is regulated with great ease and to a considerable nicety by placing one of the rollers on a lever adjustable by a screw.

We come now to notice the novelties in the department of "Dairy Mechanism;" and first we shall describe the "Churn" invented and manufactured by the manufacturer of the machine last noticed. This he calls the "Cradle Rocking Churn." It consists of a square box supported on levers or standards, two at each end, these being jointed to the framing and to the under side of the box. As the box is pushed and pulled to and fro by hand, it oscillates or vibrates on the levers from right to left, and *vica versa*, and its contents are dashed in alternately contrary directions. The machine in principle closely resembles the "swing churn" of Dr Farron and Mr Horrocks, described and illustrated by us in a former number of this Journal (1853); but we do not think it is superior in mechanical arrangements or more easily worked. The swing churn partaking of the motion of a pendulum, a large bulk of milk can be moved in it with very little expenditure of power—though it is but justice to Mr Patterson's "Cradle Rocking Churn" to say that a very large box was moved with amazing ease. The swing-churn has, however, this decided advantage over it, that the return stroke or swing is performed almost entirely by itself, the push only being given in one direction; while in the "Rock Cradle Churn"

the back motion takes as much power as the forward. According to the internal arrangements of the "rock cradle," it may be used either as a churn or as a "root-washer:" for the latter it is well adapted, so far as the washing is concerned; to fill and empty the box will take up more time, however, than is required for Crosskill's Archimedean, or Richmond and Chandler's Quadrantal Root-washer.

Mr Fisher of Thrapston exhibited a churn, the invention of the Rev. Mr Ferryman of Wadenhoe. "The interior of the churn is the section of a circle, of which the dasher may be said to be the radius. By means of a crank the dasher reciprocates from side to side of the section or churn; and on the end of the circle on which the dasher is suspended, a two-hand lever is fixed, by means of which the butter is compressed with the dasher before it is taken out of the churn."

We now notice, as the last of the novelties in the "Churn" department, the "Yankee Hydrothermal Churn," exhibited by Messrs B. Moore and Company, of 133 High Holborn, London. In mechanical arrangement this churn has a close resemblance to Wedgwood's table-churn, with which our readers are doubtless familiar, the peculiarity or principal feature residing in the "dasher," which is hollow, and can be filled with warm water in cold, and with water of the natural temperature in warm weather. All the surfaces of the dasher are curved, no angles being presented. It has three sides or surfaces, the contour resembling somewhat that of the line of beauty; the three points or apeces of these lines where two surfaces meet form a triangle nearly approaching an equilateral one. The following is the inventor's statement: "This churn is capable of producing butter without fail, in any season, and of a superior quality, and increased quantity, in from 10 to 12 minutes, not only from pure cream and sweet unskimmed, but from *sour milk*, besides the yield of butter being from *five* to *ten* per cent greater in *quantity*, and the *quality* produced better than can be produced by any other churn now in use.

"We desire to have it distinctly understood that there is no *atmospheric* principle involved in the construction and operation of the Hydrothermal Churn.

"The principles pertaining to this system are as follow: One equable uniform temperature being essential in the disintegration of the oily and serous components of cream, it becomes necessary to attain the desideratum in a certain methodical manner, which is accomplished through our improvements embracing a vertically arranged reservoir dasher, the utility of which is to distribute throughout the volume of milk or cream a more general degree of temperature, which, together with the friction produced by the succession of eddies caused by the concave and concavo-convex

chambers and gatherers, rapidly change the nature of the milk or cream."

We took occasion, in a recent article, to advert to the devices of churn inventors—their name is indeed legion—and the difficulties surrounding an intending purchaser while selecting a machine from the numbers presented to his notice. It would be doing agriculturists, and others directly interested in this branch of mechanism, great service, if some competent party were to take up the whole range of churns now before the public, and institute a rigid and impartial series of experiments, with a view not only to ascertain the best among them, but if possible to arrive at some principles which would insure a higher state of efficiency than has hitherto been attained. It is quite obvious that every inventor cannot say that *his* churn is the best extant.

In dairy apparatus, a very important invention, and which has attracted considerable attention, was exhibited by Messrs Griffiths of Bradford Street, Birmingham. This was "Keevil's Cheese-making Apparatus, for Cutting, Filtering, and Pressing Curd." If this apparatus fulfils the high character which its preliminary successes would seem to indicate it deserves, its introduction will be a great boon to dairy farmers, in facilitating what is now, and has long been, a most laborious process of the farm. It is the invention of a Mr Keevil, a gentleman who has all his life been connected with dairy farming, and who is thoroughly acquainted with all its details.

The apparatus consists of a circular vessel of zinc or galvanised iron resting upon a platform, hung upon an axis or pivot, so that the vessel can be slightly lifted to one side to allow the whey to drain off through the filter hereafter described. Across the vessel a beam is fixed, the centre of which affords a bearing for a vertical axis or spindle. On this spindle the knives are fixed. These are arranged parallel to one another, and stretch from side to side of the vessel; one half of the knives are, however, placed vertically, the other half horizontally. A handle fixed at the upper end of the spindle is used to give a rotating motion to the knives. At one side of the vessel a subsidiary receptacle, of a semicircular form, not much smaller in size, is attached; this is of the same depth as the main vessel, and communicates with it by means of a filter. This outside case is provided with a plug which fits tightly into it, and which is removed by means of handles at its upper end. A stop-cock is also provided to the outer case. So long as the plug remains in the interior of the outer case, the whey is prevented from passing through the filter; on removing it, however, which requires to be done carefully in order not to remove the filter, the whey flows through the filter into the outer case, and passes off by the stop-cock above described.

The operation is very simple. As soon as the curd is "set," the handle is turned slowly round, causing the knives on its spindle

to cut the curd very gently; when this is cut sufficiently small, the knives are removed, and the curd allowed to settle. The face of the filter is then carefully cleaned with the skimming-dish from all adhering curd, the plug removed from the outer case, and the tap opened. When the top whey has flown off, leaving the curd visible, a tub-cloth is laid over its surface, the edges being carefully placed between the curd and the vessel. A "pressing-plate," provided with a number of holes on its surface to allow the air and whey to pass up from the curd, is placed upon the latter. The bearing-arm, carrying a screw, is then placed across the vessel, and the pressure of the screw, by means of a handle, transmitted to the four arms or bearers which rest upon the pressing-plate. The pressure should be gentle at first, and gradually increased. After this, "the pressing-plate is removed, and about 6 inches of curd cut back all round the tub, placed in the middle, and the whole again pressed as before, for as long as required; it is then cut up, or ground and vatted in the usual manner."

In comparing the operation of this apparatus with the old manual process—1st, The cutting of the curd with the revolving knives, as opposed to the use of the "stirring stick," or other means usually employed; 2d, The separation of the whey from the curd by a self-acting filter, as opposed to the laborious method of cutting it with a cheese-bowl, and pressing it through a sieve; and, lastly, The pressing and drying of the curd by easily regulated mechanism, as opposed to the tedious and laborious process now in use—it may be easily understood how, by its means, labour is saved and cleanliness insured; not to mention the superiority of the article produced—a superiority which many testimonials from reliable authorities seem to establish.

We have now finished our description of novelties in the various departments we classified at the commencement of our article, and in conclusion claim the attention of the reader for a few lines further, while we notice one or two novelties not coming strictly under any of these departments; and of these we first notice the "Patent Endless Round Saw" of Messrs Barrett Exall, Reading, and Andrewes. This is, perhaps, one of the most thoroughly satisfactory inventions of recent introduction which we have been called upon to examine. From the simplicity of its arrangement, the small power required to work it, and, above all, the amazing facility which it affords to cut wood to almost any form required, it at once arrests attention. The saw is a narrow band of thin steel, yet strong and durable withal, one side of which being serrated. This endless band is passed over two drums or pulleys, one side of the saw passing through a slit made in a cast-iron table, the upper surface of which is accurately planed, and on which the wood to be cut is laid. No country mechanic should be without one of these machines. The saw is "far more economical than the

circular saw in the power consumed, and is capable of adaptation to all thicknesses of wood, and almost every variety of irregular, circular, and angular sawing. It has also the advantage that it wastes far less wood (a matter of much importance in cutting thin and small goods), and that it does not throw its dust, thus showing the line for its work clear."

Beaden's Patent Eaves Gutter Tile (exhibited by J. B. Lawes, 1 Adelaide Place, London Bridge, London), for spouting farm-buildings, is worthy of notice, from the simplicity of the means by which it proposes to effect a very important object. It is simply a tile with the lower end turned up at right angles. Some of the tiles are made with an outlet pipe or tube in the centre to carry off the water, while others are made with stopped ends, to serve as the termination of the lines. Each tile is connected to the next so as to form a perfectly even and water-tight gutter; at the upper part they are nailed to a thin batten laid along the rafters, the lower end, which forms the gutter, resting on the wall. They are sufficiently strong to allow of a ladder to be placed against them.

THE FARMERS' NOTE-BOOK.—No. LV.

What may be expected from Algiers.—There was no department of the Paris Universal Agricultural Exhibition of 1856 which showed more the wealth and importance of the country which it represented, than that of Algiers. The great variety of its products, and the early maturity of its crops, which were ready for the sickle months before those of any country in Europe, pointed to a mine of intrinsic and industrial wealth, the working out of which would engage the attention of the French Government during many years of peace, by a judicious system of colonisation, and the devising of measures best adapted for the development of its resources. An important place is now assigned to remarks on the agriculture of Algiers in all French agricultural journals, from one of which, the *Journal d'Agriculture Pratique,* we have obtained the following particulars. In 1856, reaping-machines were imported into Algiers: one, constructed on the principle of Manny's, was drawn by four horses, and required the attendance of two men. It cut about 10 acres per day, at a cost of from 12s. to 16s., including every expense except the gathering into sheaves—that is, at the rate of about 1s. 5d. per acre; while the cutting alone, with the hand, would have cost from 12s. to 16s. per acre. One of Bell's reapers was imported last year, for which one of M'Cormick's has been substituted this year, another of which was also sent over to a different part of the colony.

Threshing-machines have already been introduced. Mention is

made of a colonist whose crop was cut in the beginning of June, and threshed out by means of a locomotive steam-engine. The crop consisted of 600 cwt., or about 130 qrs., and immediately after it was threshed, it was despatched to Marseilles about the 25th of June. If a reaping-machine had been used, the farmer would have gained ten days. Thus, by the use of these two machines—a reaper and a threshing-machine—the Algerine farmer would be in a position to export his crop to Europe by the 15th of June, at a time when, after years of scarcity, the supplies in Europe are nearly exhausted. Algiers has lost every year enormous quantities of grain, an estimate of which appeared in the official reports, simply from the want of the means of expediting the operations necessary for getting the crop ready for market. In 1854, for instance, one third of the crop, or upwards of 1,000,000 qrs. of wheat and barley, were lost. And though this may appear strange, it is not the less true; for, under the burning sun of Africa, the fine kinds of wheat are very easily shaken, and it is therefore necessary to reap them before they have reached maturity. Enveloped in their bearded chaff, the coarser wheats and barley are enabled to resist better; but even they in time suffer also from the shedding of the grain; and considerable loss also is experienced from the same cause during the cutting and carrying of the crop. And from the time of the maturity of the crop to its being cut down, flocks of sparrows devour an immense quantity of the grain. Now, from want of hands, the harvest generally extends over a period of from five to six weeks, while eight or ten days would be quite sufficient to finish the whole operations required, if proper means were at the command of the farmer.

This is the true explanation of the smallness of the produce, which otherwise it is impossible to reconcile with the magnificent appearance of the harvest, and with the justly-founded fame of the fertility of the soil of Algiers. In 1854, a year noted for its great abundance, the wheat is reported at a mean only of 11 bushels per acre, while the average produce of France is about 14 bushels per acre. The usual average yield of Algiers is only about $8\frac{1}{4}$ bushels per acre—that is as much as to say that the colonists lose about the half of their produce from want of hands and machines in harvesting their crop. The advantage of reaping-machines is brought out in a stronger light in these Notes than we ever recollect of having it treated before. It is not so much the mere difference of expense between cutting a crop by machine and by hand labour, though that is not to be overlooked, but the great advantage of the farmer in this case is the saving of time, which to all intents is money. In Algiers, from the intensity of the heat and the dryness of the climate, the crop is brought rapidly to maturity; and every day that elapses after it is ripe for the sickle, increases the risk of loss from shaking in a much greater degree

than it does in this country. Besides this, the use of the reaping-machine becomes almost a necessity in Algiers, as it is in America, from the scarcity of hands to harvest the crops; while the farmer in the former country, by the combined aid of it and the threshing-machine, obtains a command of the markets of Europe at the very time when the highest price can be got for his produce. Altogether, we know not a better field for the profitable employment of agricultural machinery, for the investment of capital, and for the putting forth of the energies of the French colonist, than Algiers.

Profits from good Farming in France.—We give the following particulars, extracted from the *Journal d'Agriculture Pratique*, both to show the benefits of good farming, efficient drainage, use of guano, and the judicious selection of animals and seeds, and also to give some idea of how such things are managed in France. M. Chomel-Adam bought in April 1855 a property near Boulogne-sur-Mer. It consisted of about 112 acres of wet land, reckoned about the worst in the district, for which he paid about £1400, or nearly £13 per acre, including the buildings, which were valued at £400. Before the purchase, the rent was £40, by which the farmer was nearly ruined, and possessed only four horses, five cows, one sow, and some fowls.

The farm is now all drained at a depth of about 4 feet, and at a cost of nearly £3, 10s. per acre. The crops on it this year, which are far better than those on the neighbouring farms, are equal to, if they do not surpass, those on lands valued at £44 per acre.

The stock on the farm consists of five horses, four foals, eighteen cows in boxes, some calves, and a number of pigs, all of which have been carefully selected, and are of the best breeds, requiring an abundance of nourishing food. They are in first-rate condition, while the neighbouring farms can scarcely support some poor miserable brutes.

For the last three years, a new kind of red wheat was introduced from England, which has proved one of the most prolific that has been tried in that district, and is not liable to be affected by blight. There are rarely fewer than from 75 to 80 pickles in a head, and sometimes as many as 110 are counted from one head. A patch of ground, very wet before it was drained last year, was sown with this wheat after two imperfect ploughings, and without any manure. The plot consisted of 6½ acres, which received in spring a dressing of nearly 12 cwt. of Peruvian guano, at the time that the grass and clover seeds were sown among the wheat. The crop at the time this was written was magnificent, the probable produce of which would be about 165 bushels, the value of which for seed would be about 17s. per bushel. Thus this piece of ground, which did not exceed £80 in value before it was drained, produced the

first year a crop worth £140, not counting the straw. Besides this, there is a fine appearance of clover for 1857; a good crop of oats is sure to follow the clover in 1858; and in 1859, with an abundant manuring, which the farm will by that time be able to produce, the soil will rank among the most fertile in the district.

This has been produced by complete drainage, which cost altogether about £24, and by an outlay of £8, 12s. for guano. Thus have the results of thorough-drainage, a good dressing of guano, and a good kind of wheat, been sufficient to cover the original cost of the land and all expenses.

On Burning Clay. By J. TOWERS, M.R.A.S., &c.—In order to convey clear and definite ideas of a process which has been found to favour the growth of crops, agricultural and horticultural, upon stiff and binding lands previously all but inert, it will be proper to enter upon some investigation of the constituents of agricultural clays, as traceable by chemical analyses.

A clay soil consists of a large proportion of alumina united to silica, of various degrees of fineness, and frequently also with a portion of chalk (carbonate of lime). Alumina is an oxide of the metal (or metaloid) aluminum, discovered by Sir H. Davy in 1808. Alumina may, with some propriety, be called the *earth of alum*, as it can be obtained by decomposing a watery solution of pure alum by excess of carbonate of potash. Silica—the earth of flints—is an oxide of silicium, a substance obtained pure by Berzelius in 1824; whether or not it be a metal is not as yet certainly decided. However, silica exists in many minerals and precious stones enumerated by Brande and other chemists. Rock-crystal, quartz, Bristol stones, and Cornish diamonds, may be cited as the most familiar specimens of pure silica. A good and fertile clay soil, like the carse-lands of Scotland, and others in many parts of England, requires that the silica should be very fine, and intimately mixed with the alumina; in which case the earth, though stiff and heavy, is still plastic and laborable, and is rendered fertile in proportion to the organic and decomposable substances with which it is incorporated. With us in the south such lands are termed *clayey loams;* they form those rich wheat-soils which yield, year after year, abundant crops, provided a prudent system of rotation be adopted. But the clays of Britain are not, in general, of that genial description; and of this we possess abundant proof in the lands about Norwood, Sydenham, and the immediate vicinity of the Crystal Palace, where the clay is deep, very stiff, retentive of water, and abounding with a protoxide of iron, the presence of which is easily proved by placing a small piece of it (from Beulah Hill, for instance) on a common fire till it become red-hot throughout. When removed, it is found to have acquired the texture and red colour of a brick, the tint being produced by the conversion of

its iron into peroxide of that metal. The knowledge of this fact furnishes a key to discover the cause of that melioration of intractable clay-lands by the means of fire. But before entering farther upon its chemical agency, I would refer to the prodigious quantities of clay that were thoroughly burnt for the express purpose of preparing the walks of the Crystal Palace gardens. During three seasons one might observe immense mounds of clay smouldering in many situations exterior of that wonderful erection. The clay, when completely burnt, resembles red-brick rubbish; it is itself incapable of supporting vegetation, and is very inimical to worms. Hence the walks are safely underlaid with burnt clay, over which is placed the usual superstratum of gravel. Thus not a single weed has been seen during the two years that the public has had access to the gardens.

Some years ago the practice of clay-burning was adopted by one of those clever practical gardeners with whom I had occasion at various times to communicate, and I now refer to an article written by him on the subject. The writer begins by adverting to several practical facts, or the results of experiment upon the broad scale, made by parties whose names and residences are given, but which it will not be needful to quote. A gentleman intending to enclose a piece of strong clay-land for a garden, and knowing a celebrated agriculturist at Betley in Staffordshire, he asked his opinion on the subject, and was advised by him to let the whole be burnt, and this was done in a few weeks. Thus was completed, in so short a time, a work that otherwise could not have been accomplished in his whole lifetime—that is, he rendered the ground prolific, and wherein every sort of garden crop perfectly succeeded. Again, another gentleman, who had enclosed a piece of similar land, put the question to the writer (through the medium of *The Gardeners' Magazine*—Loudon's), "whether he could have taken any other method than adding sand, ashes, light earth, vegetable mould, and other suchlike materials, sufficient to have made a garden upon a bare rock; but, when the whole were incorporated, a *garden of clay* still remained!"

Here I must refer to a circumstance which came to my knowledge while residing in Berkshire. At a fine estate on the border of Bucks, near the Thames, there were some of the best and most fruitful kitchen and fruit gardens that I ever visited. The gardener, a clever and active man, had himself in a great degree formed and laid it out. The original staple was a binding and intractable clay. Every known meliorator was tried, but in vain: at length pit-coal ashes from the forcing-houses were tried, and succeeded perfectly. This led to the introduction of quantities of such coal-ash; and these, with thorough incorporation and deep-trenching, effected the gardener's object, and entirely corrected the texture of the land. Coal-ashes vary in quality, and their

chemical ingredients differ accordingly; nevertheless, they all are the products of combustion, and the silex, oxide of iron, and burnt earth which they contain, produce results entirely dissimilar to those obtained from raw silicious sands, which are always found incapable to subdue the intractable tenacity of inert clays.

Returning to the article first alluded to, I quote verbatim the following statements: "When I first came to this place, although the garden had been formed twenty-five years, with most excellent judgment, it was for the most part a strong clay; and within 9 inches of the surface even the most common articles would not live upon it. No weather appeared to have a good effect. At one time it was covered with water, and at another rendered impenetrable by being too dry. After witnessing the effect on a similar clay at the place (Betley) before named, I commenced burning, and in a few days produced a composition 3 feet deep, equal, if not superior, to any soil in the county" (Derbyshire). The clay is rendered pliable as burnt chalk, and seems to possess the quality of holding just a sufficient quantity of moisture, and no more: everything appears to thrive in it. As to peach-borders, I last summer applied a quantity of burnt clay to some old peach-trees, and on examining their roots in the autumn, I found abundance of good young roots growing in complete bunches; and I believe that, were those peach-borders composed of three parts of this material, they would not be attacked by those diseases so prevalent in the spring, and would be more likely to make their wood with shorter joints, and ripen much better and earlier, than they could do in a compost strongly manured. The operation of burning, and the process adopted by my able correspondent, are thus described:—

"A trench 8 feet wide, and about 3 feet deep, is thrown out; into this is placed so much small wood or faggots as will fill the trench to the level of the ground. A quantity of stronger wood, such as the roots of old trees, &c., is then superposed, which must be regulated according to the bulk of clay about to be burnt. When the whole is so completed, advantage is taken of fine weather to light the fire; and when this is done, the whole is covered up with that part of the clay which came last out of the trench, it being the strongest. As the fire advances, more earth is thrown upon the heap, making an embankment with the top soil, and of every part which contains any vegetable matter. As the fire increases, the contiguous clay is dug up, and thrown on the top; and should the weather continue dry, any more wood will seldom be required. When the violence of the fire has subsided, the soil is spread out, and on account of carbonaceous principles it has received during the process, it is rendered, in point of richness, fully equal to soot. Ground so treated will rarely want any manure for four or five years, as every species of vegetable appears to grow much too strong

during the first two years. In some cases where there is naturally much calcareous matter combined with the clay, a portion of it may be converted into lime by the process of burning. One great and permanent advantage will also result from it, for every kind of insect and pernicious weed is effectually destroyed. And where the process had been performed even years before, either slug or snail was scarcely ever observed.

Experiments on Turnips with different kinds of Manures.—In the present state of the guano market, the following experiments will, we trust, be useful to those who are at a loss as to the best substitutes to use for Peruvian guano. The whole of the field was manured with good farmyard dung, at the rate of 20 tons per imperial acre, and the following substances were applied at a cost of 26s. 6d. per imperial acre. All the different ridges, set apart for the experiments, were managed in the same way, and as there was considerable variety in the condition of the soil, we thought it better to make a series of experiments over the field, instead of one, equal portions of land being taken throughout, and the produce of adjoining ridges weighed :—

1st Ex.	Dissolved bones and Peruvian guano	gave	6 tons	2 cwt.
	Steamed bones and do.	„	6 „	8 „
2d Ex.	Steamed bones and do.	„	6 „	1 „
	Dissolved bones alone, . .	„	6 „	7 „
3d Ex.	Dissolved bones alone, . .	„	5 „	17¾ „
	Steamed bones alone, . .	„	5 „	19¼ „
4th Ex.	Leone guano alone, . .	„	4 „	7¼ „
	Leone and Peruvian guano, .	„	5 „	12¼ „

The turnips were swedes, which were all sown between the 2d and 20th of May. They escaped the ravages of the fly, and were above an average crop. The principal fact to which we would direct attention in the above experiment is, that as good a crop was grown without any Peruvian guano, and considering the relative prices of it and of steamed and dissolved bones, this season we intend to dispense with the use of it entirely on a field of similar character to that experimented on last year, and we feel convinced that we will raise as good a crop at a cheaper rate.

As a set off against this, we give the following report of a comparative trial of artificial manures at Borgue, as detailed in the *Dumfries and Galloway Standard* :—

Manures.	Quantity per Imperial Acre			Value.			Weight of Roots.				Weight of Tops.			
	cwt.	qr.	lb.	£	s.	d.	ton.	cwt.	qr.	lb.	ton.	cwt.	qr.	lb.
Peruvian Guano,	5	0	6	2	16	10	20	12	2	3	2	0	5	7
Bolivian do.,	5	0	6	2	13	0	19	15	1	22	1	12	1	25
Blood Manure,	7	2	9	2	16	10	18	5	3	11	1	2	0	21
Dissolved Bones,	7	2	9	2	16	10	17	15	0	3	2	0	2	10

The manures experimented upon were all the best of their kind. The land light, upon a clay slate, never grew turnips before, and in very poor condition.

The results may be depended upon as thoroughly accurate, "every turnip being weighed," and sufficiently extensive for all practical purposes.

We extract also the following experiment, performed at Clandeboye in County Down, under the superintendence of Mr Templeton, from the *Irish Farmers' Gazette*. Our object, in transcribing this, is to show that in many instances farmers need not hesitate to use bones as a substitute for Peruvian guano, in raising the turnip crop; for though it is mentioned that the turnips grown from the farmyard manure and guano were better than those raised from farmyard manure, and bones of equal value to the guano, still it is found that the cattle fed on the latter made greater progress than those fed on the former; and the crop of oats in the following year was also better after the manure and bones than after the manure and guano.

"The next experiment to which we shall refer is one which was made by Mr Templeton, in order to test the relative feeding properties of turnips grown on different manures. The soil of the field upon which the turnips destined for this experiment were grown was of equal quality throughout, and the preparatory cultivation of the different lots precisely similar. The seed used was Skirving's purple top swede, and the different lots were manured as follows:—1st lot, 24 tons of farmyard manure per statute acre; 2d lot, 12 tons farmyard manure and 2½ cwt. Peruvian guano per acre; 3d lot, 5 cwt. Peruvian guano per acre; 4th lot, 12 tons farmyard manure and 12 bushels of bones. Drills 28 inches apart. The cattle selected for this experiment were twelve healthy heifers of good and uniform quality, half-bred short-horns, and 2½ years old. The first result was that the turnips grown on farmyard manure alone produced the greatest weight per acre; those on the farmyard manure and guano the next; the lot on farm manure and bones third, and those grown on guano alone the lowest weight of all. When consumed, it was found that the cattle fed upon the turnips grown from farmyard manure alone made the greatest increase, the farmyard manure and bones next, the farmyard manure and guano next, and those on the turnips grown on guano alone the least. A further experiment conducted in the succeeding year showed that the value of the oats grown on the different lots was in a similar ratio. Such experiments, when carefully conducted, as they were at Clandeboye, are the surest modes of adding to the general stock of knowledge, of solving doubts, and of inducing a proper system of management, in room of one founded upon erroneous opinions."

Experiments on the Manurial Effects of certain Cakes from

Oleaginous Seeds.—The cheapness of guano, and the facility of applying it, have been such for some years as to cause farmers to overlook many other substances which used to be in high favour. Among these we may mention the refuse obtained after the expression of the oil from some oleaginous seeds, and particularly from rape-seed. Public attention has, however, this season been turned to these again, the use of which is forced upon farmers by the scarcity and high price of guano. Of late attempts have been made to introduce some of these cakes for feeding purposes, for which they seemed well adapted from the similarity of their composition to that of linseed cake. But this year we must advocate their claims more for manure, as substitutes for rape-cake, than for food, as substitutes for linseed-cake. An experiment with seven different kinds of cake was made in 1855 by M. Corenwinder to ascertain their manurial values, and the results have been published in a late number of the *Journal d'Agriculture Pratique*. In April 1855 seven different portions of a field measuring each about 8¾ poles were set apart for the experiment, and were treated alike in every respect as regards labour, and each plot was manured with 220 lb. of one or other of the following substances, and sown with equal quantities of mangold seed. The previous crop was oats. The following are the results in a tabular form:—

Name of Cake of which 220 lb. Sown.	Cost per 220 lb.	Produce in lb.	Value of Produce.	Difference between Cost of Manure and Produce.
	£ s. D.		£ s. D.	£ s. D.
Arachis or Earth-nut,	0 9 6	3194	1 2 11½	0 13 5½
Sesamum, ...	0 12 2½	3324	1 3 11½	0 11 9
Touloucanna, . . .	0 10 8	2904	1 0 11	0 10 3
Poppy, ...	0 15 0½	3487	1 5 0½	0 10 0
Camline, ...	0 14 7½	2917	1 0 11½	0 6 4
Rape, ...	0 14 3	2811	1 0 2½	0 5 11½
Hemp, ...	0 14 3	2640	0 19 0	0 4 9

Now, the seeds of which these cakes are the refuse are found abundantly in the countries in which they are cultivated or grow wild, and were imported to Lille for the purpose of having the oil expressed from them. The arachis, for instance, can be got from America, China, Spain, and the south of France; the sesamum from India, Egypt, Syria, and the West Indies; the touloucanna from Senegambia; and the others in different parts of Europe. To these we may add castor-cake, cotton-cake, and sunflower-cake, all identical in composition with those mentioned above, and the last of which can be got in great abundance in many parts of Russia, almost at the cost of the carriage, after the oil has been expressed from the seeds, which are gathered from plants flourishing

in native luxuriance in the fertile and extensive steppes of that empire. All that is wanted is a regular trade in these different substances, for their production appears to be almost boundless. Farmers, therefore, having friends in these countries where such plants are raised, would be consulting their own interest to make inquiry after them, as rape-cake is selling so very dear at present; indeed, in the foregoing table, it is quoted amongst the highest in price of the substances employed; and if we are to take the figures mentioned in the table as the relative prices of the articles, the cheapest are those principally not of European growth.

Experiments on the Potato Crop.—Autumn-planting of potatoes has been often recommended as a preventive of the disease, and also as a means of insuring a large crop. We have known it tried with various success; and we are rather inclined to argue against the practice, if we judge of the slight favour it has met with in this country. Our experience, at least, is decidedly against it. Some years ago we planted an acre or two in autumn, in a field in which there was a variety of soil. In the upper part the soil was a stiff loam, in the centre there was a knoll of sand, and at the bottom a retentive clay; the top and bottom of the field was drained every 18 feet, and 3 feet deep, so that the soil was as dry as it could be made. On examining the potato-sets after the winter, we found that those at the top and bottom of the field had either all rotted away or were destroyed by worms, and those in the sandy knoll had also suffered considerably from worms; indeed, the whole thing was so unsatisfactory that we ploughed up the ground and replanted it with potatoes. We felt satisfied, however, from this experiment, that autumn-planting should never be attempted unless on the driest soil.

Every one is not so unsuccessful as we were, as the following remarks will prove. The Vicomte de Montaignac reports in the *Journal d'Agriculture Pratique* that he has practised autumn-planting for the last three years, and that he has always been fortunate in getting both a larger and a sounder crop than from spring-planting. On 20th November 1855 he planted about 2½ roods with 14 bushels of potatoes, and on the 1st September 1856 he lifted about 87 bushels as the produce. On 15th March 1856, he planted the same quantity of potatoes on an equal extent of land of similar quality, and managed, in labouring and manuring, in every way alike as that planted in autumn; and on the 13th September following he lifted only 67 bushels of potatoes, which were neither so large nor so good as those raised from autumn-planting. This experiment agrees entirely in the results with those obtained in 1854 and in 1855 by the Vicomte.

Top-dressing with guano and other light manures being carried to a great extent for some years, and being strongly recommended

as profitable when applied to the potato crop, any experiments which test the soundness of this advice at the present time are particularly useful to the farmer. We therefore subjoin the following experiments, as performed and detailed by a gentleman signing himself "S., Inverness-shire," in the *Agricultural Gazette*, from which it will be observed that the effect of top-dressing with guano was really to reduce the crop, and that what was manured with guano alone did not produce as good a crop as what received dung alone, or partly dung and partly guano. We may mention that our experience has led us to substitute dissolved bones in a great measure for guano as an auxiliary in raising potatoes.

	Produced per Acre. Tons.	Cwts.
Lot 1. Manured at the rate of 4 cwt. of Peruvian guano, .	4	9¼
„ 2. Same manuring, and top-dressed with 2 cwt. guano on 3d July, ...	3	16¼
„ 3. Manured at the rate of 25 loads of dung, . .	4	18¾
„ 4. Same manuring, and top-dressed with 2 cwt. guano on 3d July, ...	4	15½
„ 5. Manured at the rate of 15 loads of dung and 2 cwt. of guano, ...	5	8½
„ 6. Same manuring, and planted with small potatoes, .	5	10½

We may add that we have experimented several times with different sizes of potato-sets, and have always had as good a crop from the small as from the large. In 1855 we divided a part of a field into three lots. In the one lot we planted sets of large potatoes just as they were prepared for the Glasgow market, after passing through a 1¾-inch riddle; in the second lot we planted the riddlings, cutting a piece off the end of the small potatoes; and in the third lot we planted large and small mixed, just as they had been gathered from the field, dividing the large potatoes into sets. The lots were in every way treated alike, and there was scarcely any appreciable difference in the quantity and size of the tubers raised from the three lots. We were most particular in keeping the riddlings from the produce of each lot separate, as it had been often stated to us that the tubers raised from small potatoes were always smaller. This, however, was not our experience, as we found the tubers from all the lots equally large, and the proportion of large and small in each as nearly equal as possible. We have also frequently planted diseased potatoes, and have always gathered as large and as sound a crop as where the sets were quite sound.

AGRICULTURAL SUMMARY FOR THE QUARTER.

Leases and Rotation of Crops.—The discussion of these subjects at the Hexam, the Central, the Milborne Farmers' Clubs, and several other places of late, is a strong evidence of a desire for the reconsideration of those mutual agreements between landlords and tenants in the letting of land. And considering the altered circumstances of agriculture, and the great improvements in it during the last ten years, we think that there is a call for this reconsideration. It cannot be denied, however, that to make an equitable adjustment in the relations between landlord and tenant, so as to protect the rights of the former, and, at the same time, to give full scope to the skill, enterprise, and liberal outlay of capital of the latter to meet the present requirements of agriculture, will be found to be no easy matter. And we must say that it will never be accomplished by the introduction of such clauses into leases, as that proposed at the Hexham Farmers' Club, by which the tenant is bound to pay a "further rent of £5 for every ton of turnips or mangold which shall be carried off the farm, unless purchased manure to the value of £1 for every ton of turnips or mangolds so carried off be applied to the farm within the year immediately following such sale, provided always that the said rent of £5 shall be payable only for the year in which it is incurred; the tenant being bound to give due notice to the landlord, or his agent, of his intention so to dispose of said turnips or mangold, and to produce vouchers of the purchase of the said manures." This is virtually a prohibition to sell any roots off the farm; or do the members of the club reckon the manurial value of a ton of turnips or mangold at £1? We believe that feeders seldom estimate the *full* value of a ton of turnips at more than 7s., and its manurial value at one-third or one-fourth of that sum, according to the district. And yet these gentlemen would compel a farmer to ask his landlord's permission to sell a ton of turnips, and, having obtained permission, compel him to purchase manure to the value of £1 for the ton of turnips sold. It will be said that in that district no opportunity is afforded to the tenant of disposing of his roots at any price, and that, therefore, the clause is a dead letter as concerns him. Then why insert it all? Can they predict what will take place before the 19 years of the lease are expired? Let them remember how, within the last few years, whole tracts of country have been opened up by railways, by means of which farmers at a great distance from markets have had opportunities afforded them of selling their roots at a remunerative price, and buying manure from the towns, thus benefiting themselves and improving the condition of the soil. This was not probably contemplated at the beginning of their

leases. What has happened there, may also happen in the district of Hexham.

Nor do we think that this desirable adjustment of interests between landlords and tenants can ever be accomplished by such resolutions as those passed at the Central Farmers' Club, viz.: "That it is the opinion of the meeting that the landlord who binds his tenantry down to a prescribed routine, from which they must not, under a penalty, deviate, inflicts upon them and the public a very serious injury, without conferring any corresponding advantage." The fault which we find with this resolution is, that there is far too much left to be inferred from it. We agree with the members of the club that no landlord ought to prescribe to a tenant by stringent obligations the style of farming he is to pursue for 19 years; but the resolution, being incomplete, allows a great deal more to be inferred from it, viz. that the landlord is not to impose any restrictions upon the tenant during his lease. It would certainly have been better if the resolution had been drawn up in accordance with the views stated by Mr Bennett at the meeting, that, while "acknowledging the desirability of removing the restrictions which in many cases fettered good farmers in developing the resources of the land, it must be admitted that, before you can change very largely the system of farming from the four to the five-course (that is, introducing a barley crop immediately after the wheat in the rotation), they who let the land will require some security that such privileges shall not be abused." "With spirited and good farmers, under good cultivation, it would be a great improvement; but it must ever be borne in mind that a bad farmer, with such latitude given him, might beggar the land, and that laws are not made for the good, but for the disobedient." We believe also that the clause which Mr Baker stated he had lately introduced into some leases would probably have met the views of most of the members present, and prevented their passing such a sweeping resolution. It is: "That two white crops shall not be taken in succession, unless the tenant first manured the land upon which such crop was so intended to be taken with guano, or other manure of like nature not the production of the farm, of the value of 30s. per acre at least."

It has become too much the custom with some to advocate a form of lease without almost any restrictions on the practice of the tenant. One of the aims of good farming, say they, is to bring the land into a high state of fertility, and to maintain it in that condition. This can now be done very easily by an outlay of capital in the purchase of manures. This system is the most profitable both for landlord and tenant, and to enable the tenant to carry it out, he should not be bound down to any prescribed course of cropping, or by any conditions which will fetter him in his management. This is all very right, if a landlord could be sure of every tenant farming in the same liberal and judicious manner. We cannot

refrain from quoting here the opinions of one of the most liberal advocates of liberal covenants on this subject. "It is necessary that a landlord," says Mr Caird, "in letting his farm, should protect himself from the injury which might be done to his land by injudicious cropping. For all tenant-farmers are not equally judicious in their management, and it is easy for a landlord to relax restrictions in favour of a tenant in whom he has confidence. The four-course is probably the best that can be recommended as a standard for restrictions, as it admits of easy modification and expansion." Now, some of the most restrictive leases we have seen are those agreed to by not a few farmers in the neighbourhood of Edinburgh, where they appear to manage with greater liberality and more latitude than in most other districts of the kingdom. Indeed, we would consider some of the clauses vexatious, and yet we find some of the most intelligent and independent farmers in Scotland agreeing to them, and farming well notwithstanding. For while these clauses may operate as a check on bad and unprincipled farmers, there are generally other provisions, of which the good farmer may avail himself, both for his own and his landlord's interest. For instance, by many of these leases the tenants are forbidden to sell straw and turnips, and yet that is the general practice of the district, because they are allowed at the same time to do so on condition of their purchasing a certain quantity of manure. Now, as regards the good farmer, this latter provision is superfluous, for he generally purchases far more manure than he is bound by his lease to do, knowing that it will be more profitable for him to go to this additional expense.

We should like to see as much latitude given to tenants as will be consistent with the rights of the landlord; and to accomplish this, any prescribed course of cropping, any restrictive clause introduced into a lease, should always have such a provision annexed to it as to make it an efficient check to bad or injudicious management, and at the same time no hindrance to good farming. We would hail the day when the absurd stereotyped leases throughout the country no longer existed, and such confidence between landlord and tenant subsisting as to enable the agriculture of the country to be conducted on a truly enlightened plan. We cannot agree with those who think that we should farm without rotations. A judicious farmer will always adhere to some fixed plan, so as to enable him to conduct his operations with regularity, and to have them equally distributed throughout the year. Let the rotations be as long and varied as he pleases (and we believe that the longer and the more varied they are the better), but let this practice be based on some well-considered plan.

Scottish Meteorological Society.—The first general meeting of this Society was held in January last, at which the interesting report of the committee was read, containing, among other things,

an account of the instruments to be used for observation, and the stations throughout Scotland most suitable for observations. "There were already 42 stations in different parts of Scotland which were in communication with the meteorological secretary, and from which he received monthly schedules." We were sorry to hear at the meeting that there was a difference of opinion in the committee as to the instruments to be used. We hope that the committee will come to some amicable arrangement on this point, and not allow any of their differences to interfere with the usefulness and efficiency of the Society. We listened with much pleasure to the greater part of the lecture of the secretary, Dr Stark, on the uses and objects of the Society. The remarks, however, which fell from him, while advocating the uses of meteorology to agriculture, did not meet with the approval of any practical agriculturist who heard him. We would tender an advice to Dr Stark, and those scientific gentlemen who are inclined to apply their favourite sciences to agriculture. Let them be always well versed in any agricultural facts before stating them in a company in which farmers happen to be present. They are not so ignorant of their profession as to require to be lectured *ex cathedra* on the minutiæ of some of the simplest operations on the farm, by any gentleman who may have had a liberal education, and fancies that he understands, but does not, practical agriculture. To suppose that a farmer does not know the difference between the width and the depth of the furrow, is a libel on his professional knowledge and common sense. Meteorological enthusiasts, also, must not attempt to explain every agricultural phenomenon by the rules of their science, as if agriculture was connected with and depended on meteorology for an explanation of the numerous apparent discrepancies which every now and then occur in it. Let them beware of not committing the same mistake as was done by chemists, who would make farmers believe that chemistry and agriculture were synonymous terms, and by the sad blunders that were committed by inculcating this belief, brought more discredit on chemistry than its worst enemies could have wished for, and shook the confidence of farmers in it. Scientific enthusiasts should not ride their hobbies quite so hard. We expect much good to result to agriculture from the labours of the Meteorological Society, and we would be very sorry indeed if farmers were to withhold their countenance and support from the Society on account of any injudicious remarks from its advocates.

Agricultural Labourers' Dwellings Association.—It is with much pleasure that we record the general meeting of this useful association. Considering the limited number of its members, it is surprising the amount of good that has been effected by it since its institution. We believe that its objects are as yet but imperfectly understood by the majority of proprietors. They have

nothing to do whatever with borrowing or lending money; nor does its membership impose any obligation to improve old cottages, or build new ones, according to any fixed plan. The principal objects are to direct public attention to the neglected and insufficient state of the generality of the cottages in Scotland, and to suggest and publish plans for their improvement, so as to increase the comfort of the labourer, and at the same time raise him higher in the social and moral scale. We know, from what we have seen, that these objects have been faithfully carried out by the association, and the members may congratulate themselves on the success which has attended their labours. It is one of those associations which cannot long exist. Its objects are but limited, and, being once accomplished by the removal of the circumstances which called it into existence, the services of such an association will be no longer required. But this does not at all detract from its present usefulness. We hope that the directors, in issuing their plans, will not forget the wages of the labourers; for it is as great an error to have too large a house for the income of a labourer, as for that of a farmer or of a proprietor. We have no reason, as yet, to find fault with them on this point.

Guano.—The guano question has caused considerable excitement of late among merchants and farmers. The facts of the case, we believe, to be the following. The agents of the Peruvian government gave the merchants to understand last autumn that they would have their orders executed as formerly at a rise of £1 per ton on the price of last year. On the faith of this agreement, the merchants received their orders from the farmers, mentioning this rise in the price. Before, however, any cargoes but one had been delivered in Scotland, the agents intimated to the merchants that they could not deliver the guano at the price promised in the autumn, and that it was doubtful if the quantity ordered then could be sent. If this is the true representation of the case, we must say that the conduct of the agents affords ground for serious complaint. But, at the same time, we must express a hope that, from the honourable manner in which they have hitherto acted in the guano trade, there is some mistake of which we are not aware.

We do not agree with those who are crying out so loudly at the rise in the price of guano. If there had been no promise given before of delivering it at a lower price, we have no reason to complain of an advance in it. In these days of free trade, why should not guano be sold at its true value as well as any other commodity? Why should we insist more upon the Peruvian government selling its guano at a fixed rate (acknowledged to be lower than any other manure) than the Russians their wheat, or Germany its bones? Some years guano has reached a much higher price than it is selling at at present; and who reaped the

advantage then? Why, the merchants who bought it from the Messrs Gibbs at from £9 to £10 per ton. The same element which regulated the rise in the price then should also regulate it now.

This brings us to consider the point most important to the agriculturist, viz., the obtaining a substitute for guano, or some manure that can be brought into competition with it, so as to compel the Peruvian government to reduce the price. We believe that they have done more injury to the sale of their guano than their worst enemies could have wished for. They have reduced the demand by one-half, and have held forth a premium, not merely to manufacturers of manure, but to every farmer, to try and find a substitute. And though much inconvenience will be felt in the meantime by agriculturists, there can be no doubt that ultimately great advantage will accrue to them from the conduct of the Peruvian government. Allowing the latter to do with their own as they think proper, farmers should set about compounding mixtures for themselves, and we have no doubt that for the turnip crop at least, a cheap substitute can be found for guano at its present price; and we are not sure but that also for the cereals we may get a mixture which will be as cheap and efficacious as guano at its present price. The ease with which the latter has been obtained and applied for some years, has caused us to neglect very much other most useful and important manures. We should also use every exertion in impressing upon our Government the importance of sending out vessels to search for more deposits of guano, and particularly, when such are found, to station ships of war as a protection to the vessels which may go there for cargoes, so as to prevent such encounters with ignorant barbarians as occurred at Kuria Muria in October last. And it is with much pleasure we read of the discovery of more deposits of the nitrate of soda in Peru, which will tend more than anything else to reduce the price of guano. We trust that our Government will give instructions to their consul at Pernambuco to prosecute his researches for this useful salt with vigour.

The agricultural public is now bestirring itself in this question. Several societies have sent up deputations to the Board of Trade and the Government, to urge upon them the necessity of increased vigilance and activity in searching for other deposits, by means of which the monopoly of the Peruvian government may be broken down, and the price of guano reduced to its former price, when brought into competition with a lower priced though a much inferior variety. We are glad to hear that the influential deputation representing the Highland Society has met with the fairest promises from the Board of Trade to do everything in its power to meet the views of the Society.

We are sure that the common-sense views which Dr Anderson

takes, in treating this question, in the paper which he read at the last monthly meeting of the Society, on "The Substitutes for Guano," will tend much to allay the fears felt by farmers at present in buying special manures for their crops. We quite agree with him and some others of the speakers, that we have been trusting far too much to guano for some years past, and have been entirely neglecting other most useful substitutes. For our part, we have several large fields on which 3 cwt. of guano per acre would have been applied this season if it had remained at its former low price, but which will not now get a single cwt. of it, as we have found other substitutes will produce us as good a crop at a cheaper rate; and we are aware of many farmers who have determined to do the same. We would advise agriculturists generally to encourage those dealers who are now selling by analysis, as by their exertions, and the skill and enterprise of the manufacturers for whom they sell, we expect to find a substitute for the Peruvian guano. And if owing to the present high price of this valuable article, farmers can be made to pay more attention to their manure-heaps at home, and to using other profitable substitutes for guano, they will have to thank the Messrs Gibbs for the annoyance they have caused them at present, and for proving, what they never intended to be, the farmers' best friends.

Sewage.—This important subject has been a third time discussed at the Society of Arts in London. It is more important, we conceive, as a sanitary than as merely a manurial question. And the more we consider it, the more are we convinced that every view of it, whether economical or agricultural, must yield to the sanitary. The sewage of our towns must be got quit of. If this can be done by rendering the substances contained in it profitable to the farmer, by any process, the expense of which can be repaid or more than repaid by the sale of the products, without being offensive to any residing in the neighbourhood of works erected for conducting the process, then we may say that the sewage problem is solved. But if this cannot be effected, then, perhaps, the best way is to get the sewage away to the ocean as quickly and cheaply as possible. A deodorising process has been tried on a large scale at Leicester, where works have been erected, and the insoluble matter of the sewage precipitated by cream of lime, according to the plan of Mr Wicksteed, and then collected and sold at a very low rate to those who will purchase it. But it is plain, that so long as the soluble—that is, the valuable part of the sewage—is allowed to escape, what is left behind can possess but a very low manurial value. And the analysis of it by Professor Voelcker bears us out in this statement, for it shows that what is collected contains only 0.72 per cent of ammonia, 52.99 per cent of carbonate of lime, 10.52 per cent of lime, and 13.50 per cent of insoluble silicious matter, the other ingredients being comparatively

valueless. We believe that many chemists are now engaged in trying to discover some compound insoluble salt, of which ammonia will be one of the bases, and will thus become precipitated and mixed up with the solid matters. Till this or some other plan of fixing the ammonia and other soluble salts be discovered, we are afraid that the sewage cannot be profitably used in agriculture, excepting by irrigation. But this will be objected to again on sanitary grounds, so that in the present state of our scientific knowledge, the disposal of the useless, but at the same time valuable matter, is a problem most difficult of solution. We have abundant evidence of its powerful effects when used for irrigation in the neighbourhood of Edinburgh, where land, not worth originally £5 per Scots acre, lets annually now for £25, and sometimes for £48 per Scots acre; and there is considerable difference of opinion yet as to its prejudicial effects on the health of those who reside in the vicinity of the irrigated meadows.

Shows of Fat Stock and Poultry.—There are few things in which the English and Scotch farmers, and public generally, differ so much as in the interest which they manifest in exhibitions of fat stock. During the last quarter, and particularly in the month of December, all the principal towns of England held their exhibitions of fat stock, which proved as attractive to the townspeople as to those from the country. They were the principal topic of conversation for a while, and no newspaper would peril its existence by refraining to make a few remarks on them, and giving a full report of the proceedings. The Smithfield, Birmingham, Newcastle, Darlington, and a host of other fat-stock shows, have all been successfully held, and have at the same time been made an occasion of public feasting and after-dinner speechifying. Contrast this with what has been attempted in Scotland for the last three years, where we find the greatest indifference both among the public and agriculturists, and the consequent utter failure in the attempt. Two years the Highland Society tried Christmas shows, by which they lost large sums of money. Last year the Glasgow Society also attempted it, and it was deservedly made matter of complaint that those most interested in these exhibitions did not give it their countenance. It may be asked, What was the cause of these failures? It certainly was not from the want of fine animals, for at all the three shows there were animals exhibited which could compete with any at the English shows. It was not from the insufficiency of the premiums: these were large enough to bring out very fine animals, and the prices given for those that gained the prizes were tempting enough, and showed at least that the fleshers appreciated such shows. We are afraid that we must look for the cause of the failure in the prejudices of the Scotch against fat beef and mutton. We do not intend to dilate here on the difference in favour of well-fed over indifferently fed meat, and of

the profit of the former both to the feeder and to the consumer; nor shall we speak at present of the insight which farmers would obtain from such shows in the selection of the kinds of animals which would prove most profitable to them for feeding, and in the use and value of many kinds of substances for feeding which are now almost quite unknown to them. It is evident that the true objects of fat-stock exhibitions are not understood in Scotland, or they would meet with more favour than they do at present.

The Smithfield and Birmingham shows last Christmas fully maintained their previous character; nor did they clash with one another in being held at the same time. The Birmingham being before the Smithfield, many of the animals were sent from it to the latter, and, curious enough, several of the awards of the judges at Birmingham were reversed at Smithfield. The extensive exhibition of roots, implements, and poultry, also at both places, was a source of attraction to many who would not have cared for the fat animals alone; so that the visitors, during the whole time of the exhibitions, were numerous. We consider these shows most interesting, useful, and instructive to the farmer, particularly when they are followed up by such details of the feeding of the animals, and of the cultivation of the roots exhibited, as that made out of the roots exhibited by the Royal Dublin Society. We have more than once directed attention to the importance of bestowing more care in the management of poultry than is general in Scotland. The complaint by farmers is, that poultry does not pay, and that it is not consequently worth while paying much attention to them. Now, poultry cannot pay unless they are properly attended to, as they universally are not in Scotland; but neither can cattle or sheep pay unless proper attention is bestowed on them. We admit that the accommodation on farm-steadings is generally not sufficient; but let farmers impress on the proprietors the necessity of having it improved, and we have no doubt that through time this will be done. At present the fault lies with the farmer. The Crystal Palace has also this year added to its other attractions a show of poultry, which has proved most successful in the number and quality of the birds exhibited, and in the number of visitors.

The French have with their usual munificence increased their premiums at their annual fat show at Poissy, which is to be held in the beginning of April. Scotland may feel flattered at the favours extended to her in having her cattle put upon an equal footing, in the amount of premiums, with those foreign cattle which are most esteemed in France. We hope that her farmers will show that they appreciate this distinction, by trying to make the shows of their native fat stock as complete as that of the breeding stock was at the Universal Exhibition at Paris last year. For it has been well said, that the "Poissy show is a corollary to the great show of breeding animals in Paris in June last." We are

sorry to hear that the great show advertised to be held at Paris this year has been postponed to next year, owing, we are informed, to those districts which suffered from the inundations last year not being able to avail themselves of the opportunity afforded them of being exhibitors of their native stock and products.

Road Reform.—This question has made considerable progress during the last quarter. Lord Elcho has issued the draft of a bill to be introduced into Parliament for the abolition of tolls, and substituting another method for raising funds for keeping up the roads. Several newspapers have expressed decided opinions in favour of the question, and most of the counties have also discussed it. It is evident that public interest has now been thoroughly awakened in the question, and sooner or later there must be a change. The simple fact of a bill being drafted for the abolition of tolls is a great step gained by the road reformers. The discussions in the counties have not been very searching and enlightening. They seem to have been entered upon rather with the determination of throwing the question aside, than of sifting it thoroughly. In few instances was the attempt made to discuss the principle of Lord Elcho's bill; the unworkable parts in the details of the bill only were strongly commented on, by doing which it was thought the question would be strangled at its birth. But those who think so, certainly misjudge the feelings of the public. We consider it no bad augury of the success of the question that such unanimity prevails among its advocates. A third edition of Mr Pagan's work has most appropriately been issued, in which the history of road reform to the present time is forcibly sketched. There is consequently much new matter in it, and all the schemes that have been suggested as substitutes for tolls are impartially stated. It is very much to the credit of Mr Pagan that he has now given the preference to a land-rate instead of a rate on horses, which was first proposed by him, and might be said to have been peculiarly his own scheme. His reasons for this preference are given fully in his book. We are certain that the question will be as much indebted to the third edition for the impetus which will be given it now, as it was to the first edition for the start it received in public favour.

AVERAGE PRICE OF THE DIFFERENT KINDS OF GRAIN,

PER IMPERIAL QUARTER, SOLD AT THE FOLLOWING PLACES.

LONDON.

Date.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1856.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 6.	69 1	43 10	29 3	35 0	46 10	42 8
13.	68 10	44 11	22 10	38 6	46 4	41 2
20.	64 4	43 10	27 11	39 2	45 8	39 6
27.	65 5	43 10	26 4	40 2	44 4	39 7
1857.						
Jan. 3.	64 3	46 7	24 5	39 7	44 6	38 1
10.	63 9	48 4	26 0	39 2	42 0	39 0
17.	64 1	48 6	23 4	38 6	40 8	38 5
24.	64 10	44 9	25 2	39 2	40 5	38 2
31.	62 10	46 0	24 7	38 8	41 3	38 11

EDINBURGH.

Date.	Wheat.	Barley.	Oats.	Pease.	Beans.
1856.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 3.	48 9	39 6	25 11	39 8	40 5
10.	47 1	37 10	25 4	39 2	40 1
17.	47 6	36 3	24 0	42 6	53 1
24.	42 10	35 8	24 4	42 10	43 9
31.	42 5	35 1	22 11	38 6	39 4
1757.					
Jan. 7.	42 10	35 11	23 5	39 4	40 2
14.	41 5	36 6	22 11	37 6	38 0
21.	41 7	37 11	24 11	37 4	38 1
28.	39 5	37 10	25 3	37 6	37 11

LIVERPOOL.

Date.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
1856.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 6.	58 6	43 9	28 3	36 10	43 8	43 6
13.	58 5	45 4	23 7	38 2	42 1	44 0
20.	57 8	45 4	23 3	39 4	38 4	44 0
27.	56 7	43 7	23 7	40 4	39 6	42 3
1857.						
Jan. 3.	58 2	45 11	24 6	38 10	40 4	40 10
10.	58 0	42 6	23 7	39 6	41 9	36 10
17.	58 8	45 4	24 11	38 2	43 0	44 5
24.	58 9	43 1	24 1	38 10	40 1	42 0
31.	57 4	37 2	24 0	38 4	41 9	45 10

DUBLIN.

Date.	Wheat, p. barl. 20 st.	Barley, p. barl. 16 st.	Bere, p. barl. 17 st.	Oats, p. barl. 14 st.	Flour, p. bar. 9 st.
1856.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 5.	36 5	21 8	15 4	13 6	25 2
12.	36 1	21 6	15 6	13 10	25 4
19.	35 8	21 10	14 10	13 11	24 8
26.	35 2	22 1	15 2	13 6	24 10
1857.					
Jan. 2.	34 0	22 5	15 6	13 4	24 10
9.	34 1	22 7	15 10	13 7	25 1
16.	33 2	23 1	16 2	13 2	24 9
23.	33 5	25 1	16 6	12 11	24 8
30.	32 0	22 9	15 10	13 0	24 6

TABLE SHOWING THE WEEKLY AVERAGE PRICE OF GRAIN,

Made up in terms of 7th and 8th Geo. IV., c. 58, and 9th and 10th Vict., c. 22. On and after 1st February 1849, the Duty payable on FOREIGN CORN imported is 1s. per quarter, and on Flour or Meal 4½d. for every cwt.

Date.	Wheat.		Barley.		Oats.		Rye.		Pease.		Beans.	
	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.	Weekly Average.	Aggregate Average.
1856.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Dec. 6.	60 11	63 7	43 10	45 8	25 0	25 9	38 11	40 10	41 1	43 8	44 5	46 1
13.	60 1	62 8	43 1	45 1	23 5	25 8	42 1	40 11	41 10	43 1	43 7	45 6
20.	60 5	61 10	43 10	44 8	25 6	25 1	40 2	40 10	40 9	42 3	42 8	44 11
27.	59 8	61 1	43 11	44 2	23 7	24 8	39 9	40 7	40 2	41 9	42 4	44 2
1857.												
Jan. 3.	58 1	60 2	44 8	44 4	23 5	24 3	39 2	40 4	40 9	41 3	41 5	43 4
10.	58 10	59 8	44 7	44 0	23 8	24 1	38 5	39 9	39 9	40 9	41 7	42 8
17.	59 4	59 5	45 7	44 3	23 4	23 10	40 2	40 0	39 6	40 6	40 5	42 0
24.	58 10	59 2	46 1	44 9	23 8	23 1	37 8	39 3	39 6	40 1	40 8	41 6
31.	57 11	58 9	46 5	45 3	23 4	23 6	38 1	38 11	39 7	39 11	40 5	41 2

FOREIGN MARKETS.—Per Imperial Quarter, free on board.

Date.	Markets.	Wheat.	Barley.	Oats.	Rye.	Pease.	Beans.
		s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
1856. Dec. ..	Danzig	52 6 - 64 0	29 6 - 35 0	16 0 - 21 6	33 0 - 39 6	34 0 - 40 0	34 6 - 41 0
1857. Jan. ..	Danzig	50 0 - 61 6	29 6 - 34 0	16 6 - 23 0	32 6 - 37 6	32 6 - 38 0	33 0 - 38 6
1856. Dec. ..	Hamburg	52 0 - 58 6	28 6 - 35 6	16 0 - 20 6	32 6 - 38 6	31 6 - 38 6	33 6 - 40 0
1857. Jan. ..	Hamburg	50 6 - 55 9	31 0 - 38 0	14 6 - 20 0	32 0 - 37 6	30 0 - 36 0	28 6 - 32 0
1856. Dec. ..	Bremen	54 6 - 68 6	28 6 - 38 0	14 6 - 20 6	28 6 - 39 6	28 6 - 39 0	32 0 - 38 6
1857. Jan. ..	Bremen	51 6 - 61 0	30 6 - 39 0	13 6 - 20 0	27 6 - 38 0	26 6 - 37 6	30 0 - 33 6
1856. Dec. ..	Königsberg	49 6 - 53 6	30 6 - 39 0	14 0 - 19 6	30 6 - 38 6	30 2 - 38 6	32 6 - 39 0
1857. Jan. ..	Königsberg	50 6 - 58 0	31 0 - 38 0	13 6 - 20 0	28 6 - 36 6	28 6 - 37 0	30 6 - 38 6

Freights from the Baltic, from 3s. 6d. to 5s. 6d.; from the Mediterranean, 6s. 6d. to 10s. 6d.; and by steamer from Hamburg, 4s. to 6s. per imperial qr.

THE REVENUE.—From 1st October to 31st December 1856.

	Quarters ending Dec. 31. 1855.	Quarters ending Dec. 31. 1856.	Increase.	Decrease.	Years ending Dec. 31. 1855.	Years ending Dec. 31. 1856.	Increase.	Decrease.
	£	£	£	£	£	£	£	£
Customs	5,707,101	6,232,175	525,074	..	22,534,302	23,618,375	1,084,073	..
Excise	4,604,000	4,816,000	212,000	..	17,269,463	18,073,778	804,315	..
Stamps	1,749,769	1,838,000	88,231	..	7,132,824	7,268,272	135,448	..
Taxes	1,351,000	1,356,000	5,000	..	3,095,543	3,105,026	9,483	..
Post-Office ..	647,000	748,000	101,000	..	2,704,000	2,869,152	165,152	..
Miscellaneous	430,317	281,842	..	148,475	1,383,523	1,255,963	..	127,560
Property Tax	1,335,373	1,423,464	88,091	..	14,121,561	16,028,422	1,906,801	..
Total Income	15,824,560	16,695,481	1,019,396	148,475	68,241,216	72,218,988	4,105,272	127,560
	Deduct decrease....		148,475		Deduct decrease....		127,560	
	Increase on the qr...		870,921		Increase on the year		3,977,712	

PRICES OF BUTCHER-MEAT.—Per Stone of 14 Pounds.

Date.	London. Beef.	London. Mutton.	Liverpool. Beef.	Liverpool. Mutton.	Newcastle. Beef.	Newcastle. Mutton.	Edinburgh. Beef.	Edinburgh. Mutton.	Glasgow. Beef.	Glasgow. Mutton.
	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
1856. Dec. ..	6 6 - 8 9	7 6 - 9 3	6 3 - 7 9	6 6 - 8 9	6 3 - 8 3	6 6 - 8 6	6 3 - 8 3	6 6 - 8 6	6 3 - 8 3	6 6 - 8 6
1857. Jan. ..	7 3 - 9 3	7 6 - 9 6	6 0 - 8 0	6 3 - 8 6	6 6 - 8 4	6 6 - 8 6	6 6 - 8 6	6 6 - 8 9	6 6 - 8 6	6 6 - 8 9

PRICES OF ENGLISH AND SCOTCH WOOL.—Per Stone of 14 Pounds.

ENGLISH.	s. d. s. d.	SCOTCH.	s. d. s. d.
Merino,	21 6 to 28 6	Leicester Hogg,	21 6 to 26 6
.. in grease,	18 0 to 22 6	.. Ewe and Hogg,	19 0 to 24 0
South-Down,	20 0 to 25 6	Cheviot, white,	18 0 to 22 6
Half-Bred,	16 6 to 21 0	.. laid, washed,	11 6 to 15 6
Leicester Hogg,	18 8 to 24 6	.. .. unwashed,	9 6 to 13 0
.. Ewe and Hogg,	16 6 to 22 0	Moor, white,	8 4 to 11 8
Locks,	9 0 to 12 0	.. laid, washed,	6 6 to 9 4
Moor,	7 6 to 9 0	.. .. unwashed,	5 6 to 7 4

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